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The Engineer

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PUBLIC NOTICES

The High Commissioner for India is prepared to receive TENDERS for the SUPPLY of:—MACHINE FOR GRINDING LOCOMOTIVE CRANK PINS.

Forms of Tender may be obtained from the Director-General, India Store Department, Belvedere-road, Lambeth, S.E. 1, and Tenders are to be delivered at that office not later than two o'clock p.m. on Friday, the 24th March, 1922.

T. RYAN,
Director-General.
7628

British Standardised Steel SAMPLES

Issued jointly by
THE IRON AND STEEL INSTITUTE
AND THE
NATIONAL PHYSICAL LABORATORY.

These samples are now available, together with certificate of standardisation, at the price of 21s. per bottle, containing 50 grammes. They may be obtained post free by sending order with remittance direct from

THE NATIONAL PHYSICAL LABORATORY (Metallurgy Dept., Teddington, Middlesex;
or by post or personal application from
The Secretary, NORTH MIDLANDS DISTRICT AUTHORITY, Dept. of Applied Science, The University, Sheffield.

Depots in other centres are being arranged.

The Standards at present available are:—
No. 5 Carbon (C = 0.45 per cent.) Acid O.H. Steel.
No. 6 Carbon (C = 0.10 per cent.) Basic O.H. Steel.
No. 1 Sulphur (S = 0.027 per cent.).
No. 2 Sulphur (S = 0.071 per cent.).

Others are in preparation and will be issued when ready.
7048

Borough of Camberwell.
TO ENGINEERS, BOILERMAKERS, &c.

The Council invite TENDERS and SCHEMES for ONE NEW WATER-TUBE STEAM BOILER; TWO NEW STEAM CALORIFIERS and other work in connection with the re-arrangement of the Boiler-house at the Public Baths, Church-street, Camberwell, S.E. 5.

Specification and form of Tender can be obtained from Mr. Frederick J. Slater, Borough Engineer, Town Hall, Camberwell, S.E. 5.

Tenders, together with complete drawings and full particulars of proposed schemes, must be delivered on or before Thursday, 23rd March, 1922, not later than 5 p.m.

C. WILLIAM TAGG,
Town Clerk.
7609

County of West Sussex.
NORFOLK BRIDGE, OVER RIVER ADUR, SHOREHAM-BY-SEA.
TO BRIDGE WORK CONTRACTORS.

The West Sussex County Council is prepared to consider TENDERS for the entire RECONSTRUCTION of the SUPERSTRUCTURE of the above BRIDGE under the West Sussex County Council (Bridges) Act, 1918, 8 and 9 Geo. V. c. XLI., together with the partial RECONSTRUCTION of both ABUTMENTS, the PROVISION of ONE NEW PIER, and the possible STRENGTHENING of TWO existing PIERS.

The new superstructure will consist of four bowstring girders, having an approximate total length of 230ft., the roadway being 18ft. in width and having two cantilever paths. Contractors may tender either

(1) For the whole of the work;
(2) For the masonry and the demolition of the existing bridge only;
(3) For the steel work and its erection only.

Plans, specifications, and bills of quantities may be seen at the offices of the Consulting Engineers to the County Council, Howard Humphreys and Sons, 28, Victoria-street, Westminster, S.W. 1, between the hours of 10 a.m. and 4 p.m. on and after March 17th, 1922, until March 24th.

Contractors requiring specifications and quantities will be able to obtain the same by depositing Ten Guineas with the above-named Consulting Engineers; such sum will be refunded on receipt of a bona fide Tender. Contractors may, if they wish, order a set of blue prints of the work at the time of inspecting the drawings and upon payment of the net cost of the prints.

The successful contractor will be required to execute a contract deed as prepared by the undersigned, the draft of which may be inspected at the offices of the Consulting Engineers.

Tenders must reach the undersigned not later than 9 a.m. on Monday, April 3rd next, marked "Norfolk Bridge Tender" on the outside of the envelope.

The County Council does not bind itself to accept the lowest or any Tender.

Dated the 7th day of March, 1922.

S. THORNELY,
Clerk to the West Sussex County Council,
51, East-street, Horsham.
7631

Edinburgh Corporation Electricity Supply.
PORTOBELLO STATION.

The Lord Provost, Magistrates and Council invite TENDERS for the following WORK:—

SPECIFICATION No. 42.—CONVERTING PLANT FOR LIGHTING AND TRACTION.

SPECIFICATION No. 43.—D.C. SWITCHGEAR.

A copy of the specification and accompanying drawings can be obtained from Sir Alexander B. W. Kennedy, 17, Victoria-street, Westminster, S.W. 1, on and after Tuesday, 14th March, upon payment of a deposit of £2 2s. An additional copy of the specification can be obtained upon payment of a deposit of £1 1s. These deposits will be returned after the receipt of a bona fide Tender and on the return of the specification and drawings.

Tenders, on the prescribed form, enclosed in sealed envelopes, and addressed on the outside "Electricity Supply, Tender to Specification," must be delivered at the office of the undersigned not later than Saturday, the 15th April, 1922, at 10 a.m.

A. GRIERSON, S.S.C.,
Town Clerk.
City Chambers, Edinburgh,
March, 1922.
7603

The National Foremen's Association of the ENGINEERING AND ALLIED TRADES.

(Registered under the Trade Union Act.)

An Association specifically formed to look after the interests of Foremen in their Supervisory Capacity.

All communications to Head Office,
H. W. REID, 95, Belgrave-road,
General Secretary, Victoria, S.W. 1.
&c.

PUBLIC NOTICES

London County Council.

TENDERS are INVITED for the MANUFACTURE, SUPPLY, DELIVERY, and ERECTION at Greenwich Power Station of—

(A) An ASH CONVEYOR of the water immersed, drag-link type.
(B) An ASH HOPPER.

The specification, form of Tender, and general conditions may be obtained from the Clerk of the Council, County Hall, Spring-gardens, S.W., upon payment to the Cashier of the Council of a deposit of £2. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Particulars of the work may be obtained on application at the County Hall before the payment of the fee.

Tenders must be addressed to the Clerk of the Council and delivered at the County Hall, Spring-gardens, S.W. 1, not later than 4 p.m. on Monday, 10th April, 1922. No Tender received after that time will be considered.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD,
Clerk of the London County Council.
7630

Manchester Corporation Waterworks.
THIRLMERE AQUEDUCT.—FOURTH PIPE LINE.
DISCHARGE VALVES, &c.

The Waterworks Committee invite TENDERS for the SUPPLY of 6in. DISCHARGE VALVES, MANHOLE DOORS, LADDERS, JOISTS, and other IRONWORK.

Specification, form of Tender, &c., may be obtained on application to the Secretary, Waterworks Offices, Town Hall, Manchester, upon payment of a deposit of Three Guineas, which will only be returned to the tenderer provided that he shall have sent in a bona fide Tender and shall have returned the documents and the drawings lent to him, the drawings to be unmarked. Further information, if required, may be obtained from the Waterworks Engineer.

Sealed Tenders, endorsed as directed, must be delivered at the Waterworks Offices, Town Hall, Manchester, not later than the 25th March, 1922.

By Order,
THOMAS HUDSON,
Town Clerk.
Town Hall, Manchester,
7th March, 1922.
7506

Royal Gwent Hospital, Newport, Mon.
TO HEATING ENGINEERS.

The Directors of the Hospital invite Heating Engineering Firms to submit SCHEMES for HEATING and HOT WATER SUPPLY to the new Out Patients' Department, for NEW BOILERS, and for such ALTERATIONS as may be required to the existing Heating Installation, together with TENDERS for the work.

Firms desirous of tendering may obtain copies of the plans and particulars upon application to us, accompanied with a deposit of £5 5s., which will be returned upon receipt of a bona fide Scheme and Tender.

All applications for particulars must be sent not later than 17th March, 1922.

The Directors do not bind themselves to accept the lowest or any Tender.

GRIGGS and VAUGHAN,
Architects.
Metropolitan Bank Chambers,
Newport, Mon.
7558

Sligo, Leitrim, and Northern Counties Railway Company.

The Directors are prepared to receive TENDERS for 240 TONS of British Standard FLAT-BOTTOM STEEL RAILS, 75 lb. per yard, with the necessary FISH-PLATES, 4 holes in each rail. Length of rails to be 45ft., with 7½ per cent. of shorts; no rail to be less than 30ft. long.

Delivery into trucks, Belfast, Dundalk, or Londonderry, not later than Saturday, 20th May, 1922.

Tenders to be addressed to SECRETARY, S.L. and N.C. Railway, Enniskillen.

The Directors do not bind themselves to accept the lowest or any Tender.
7617

PUBLIC NOTICES

Metropolitan Water Board.
WALTON TO HONOR OAK MAIN.
SECTION No. 3.
TENDER FOR THE LAYING OF A MAIN FROM CLAPHAM PARK TO PECKHAM RYE.

The Metropolitan Water Board invite TENDERS for the LAYING and JOINTING of about 9400 LIN. YARDS of CAST IRON WATER MAIN, 48in., 42in., and 36in. in diameter, from Thornton-road, Clapham Park, to the junction of Colyton-road and Homestall-road, Peckham Rye, in the County of London, together with contingent works.

Drawings, conditions of contract, and specification may be inspected without payment of fee at the offices of the Board, Chief Engineer's Department (Room 201), on and after Monday, 13th March, 1922.

Forms of Tender, conditions of contract, specification, bills of quantities, and schedules of prices, together with a spare copy of the bills of quantities and schedules of prices, may be obtained on and after 13th March, 1922, from Mr. Henry E. Stilgoe, M. Inst. C.E., the Chief Engineer, on production of an official receipt for the sum of £20, which sum must be deposited with the Accountant to the Board, and will be returned on receipt of a bona fide Tender, accompanied by all the above-named documents (with the exception of the spare copy of the bills of quantities and schedules of prices, which may be retained by the tenderer). Such payments and applications must be made between the hours of 10 a.m. and 4.30 p.m. (Saturdays, 10 a.m. and 12 noon).

Tenders, enclosed in sealed envelopes, addressed to "The Clerk of the Board, Metropolitan Water Board, New River Head, 173, Rosebery-avenue, Clerkenwell, E.C. 1," and endorsed "Tender for Main, Walton to Honor Oak, Section No. 3," must be delivered at the offices of the Board not later than 10 a.m. on Monday, 10th April, 1922.

The Board do not bind themselves to accept the lowest or any Tender.

W. MOON,
Clerk of the Board.
Offices of the Board,
New River Head,
173, Rosebery-avenue,
Clerkenwell, E.C. 1,
4th March, 1922.
7608

All Interested in Belgian ENGINEERING SPECIALITIES and CONTINENTAL MANUFACTURES are INVITED to VISIT the BRUSSELS INTERNATIONAL COMMERCIAL FAIR, held from 2rd to 10th APRIL.

Buyers' cards and information regarding lodgings free on application.

19, Grand' Place, Brussels.
7598

Swansea Harbour Trust.

The Trustees invite TENDERS for the SUPPLY and DELIVERY of the following:—

950 NEW CREOSOTED SLEEPERS, 9ft. by 10in. by 5in.
Approximately 2300 cu. ft. 12in. by 6in. PITCH PINE CROSSING TIMBERS, in length varying from 9ft. to 26ft. A schedule of length will be supplied.
About 47 Tons CAST IRON RAILWAY CHAIRS, approximately 44½ lb. each.
About 6 Tons of 7/8in. by 4in., and about 5 Tons of 8/8in. by 4in. FANG BOLTS, with 3in. Triangular Shoes.

Further particulars may be obtained of the Trustees' Engineer, Mr. A. O. Schenk, M.I.C.E., Harbour Offices, Swansea.

Tenders, sealed and marked "Railway Material," to be delivered to the undersigned on or before 17th March, 1922.

The Trustees do not bind themselves to accept the lowest or any Tender.

TALFOURD STRICK,
Clerk.
Harbour Offices, Swansea,
March 1st, 1922.
7579

PUBLIC NOTICES

Swansea Harbour Trust.

The Swansea Harbour Trustees invite TENDERS for the REPAIR of certain FERRO-CONCRETE QUAYS in their King's Dock, by means of the Cement Gun. The quays may be inspected, and further particulars of the nature of the repairs to be executed may be obtained on application to the Trustees' Engineer, Mr. A. O. Schenk, M.I.C.E., Harbour Offices, Swansea.

Tenders, marked "Repairs to Quays," should be delivered to the undersigned not later than 10 a.m. on Friday, the 24th March, 1922.

The Trustees do not bind themselves to accept the lowest or any Tender.

TALFOURD STRICK,
Clerk.
Harbour Offices, Swansea,
25th February, 1922.
7544

Brownhills Urban District Council.
APPOINTMENT OF ENGINEER AND SURVEYOR.

The Urban District Council of Brownhills (Staffs) invite APPLICATIONS for the OFFICE of ENGINEER and SURVEYOR.

Preference will be given to candidates who have qualified as members of either the Institution of Civil Engineers or the Institution of Municipal and County Engineers.

The person appointed will be required to carry out the various duties imposed upon him by the Public Health Acts and other general statutes and such other duties as may be determined by the Council.

He will be provided with offices and assistance and will be required to devote his whole time and attention to the duties of the office and not to engage in private work or other business, and to give approved security and reside in the district.

The engagement will be during the pleasure of the Council and capable of termination by three months' notice on either side. Applications, stating age, salary required, qualifications and experience, accompanied by copies of not more than three recent testimonials, must be sent to the undersigned not later than 5th April, 1922.

Canvassing, directly or indirectly, will be a disqualification.

W. FRED. HALL,
Clerk to the Council.
21, Park-street, Walsall,
8th March, 1922.
7637

SITUATIONS OPEN

WANTED, ENGINEER, to Assist Chief Engineer in large manufacturing firm in Birmingham district. Must have had sound theoretical training and experience in Foundry and Modern Machine Shop methods, including Design of Jigs. Keenness and tact essential; only good men need apply. State age, salary required, experience, and references.—Address, 7614, The Engineer Office. 7614 A

WANTED in a Municipal Engineer's Office in the North of England, a young MECHANICAL ENGINEER with good theoretical and practical experience. A knowledge of the handling of men and materials would be an advantage.—State age, full particulars of experience, and salary to Box 999, c/o Judd's, 97, Gresham-street, London, E.C. 2. 7546 A

WANTED, SALESMAN, with Connection, Capable of handling Steam Specialities, Feed Pumps, &c. Salary and previous experience.—Address, 7613, The Engineer Office. 7613 A

CARBON DRILLS OR SMALL TOOLS.—We WANT a GENTLEMAN who has a good connection with the above tools. A progressing BERTH is OFFERED with DIRECTORSHIP.—Address, 7567, The Engineer Office. 7567 A

DESIGNER (First-class Loading). Accustomed to Land Engine Work; also a knowledge of Boiler Design would be a recommendation.—Apply, JAMES CARMICHAEL and CO., Ltd., Dundee. P5071 A

SALES REPRESENTATIVE REQUIRED for Second-hand Machinery Merchants. Must be qualified engineer. Preference given to one taking shares.—Address, P5065, The Engineer Office. P5065 A

YOUNG CIVIL ENGINEER REQUIRED IMMEDIATELY for Nigeria by Firm of Contractors, as General Assistant. Should have experience in Erection of Bungalows, Buildings, Costing, Estimates.—Address, with full particulars and salary required, 7638, The Engineer Office. 7638 A

WANTED, DRAUGHTSMAN, with First-class Up-to-date experience in the design and details of Colliery Screening and Coal-handling Plants.—Address, giving full particulars of experience, salary required, and age, 7602, The Engineer Office. 7602 A

ADDITIONAL DRAUGHTSMAN REQUIRED for general engineering work.—Apply by letter, stating age, experience, salary required, &c., to ROWNTREE and CO., Ltd., Engineering Department, York. 7620 A

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APPLICATIONS are INVITED from DRAUGHTSMEN or ENGINEERS who have had a wide experience in Coal Washeries, preferably from those having experience with Humboldt or other German Coal-washing Plants, and capable of designing similar arrangements throughout. The position will be a progressive one, and for the right man would lead to the complete charge of this department.—State age, experience in full, and commencing salary to NORTONS (Tividale), Limited, Hyria Works, Tipton. 7595 A

DETAIL DRAUGHTSMAN or IMPROVER WANTED for Small Steel Construction Shop. Single man preferred.—Address, stating salary required, age, and experience, 7644, The Engineer Office. 7644 A

DRAUGHTSMAN REQUIRED for Electricity Power Station. Knowledge of E.H.T. Switchgear and Circuits essential. Must have had a sound electrical training. Preference will be given to qualified applicants residing within the borough of Stepney.—State training, experience, and salary required to ENGINEER, 27, Osborn-street, Whitechapel, E. 1. 7605 A

DRAUGHTSMAN WANTED by Firm Specialising in Excavating Machinery; must essential to be a sound detailer for making working drawings. State age, experience, terms, &c.—Address, 7619, The Engineer Office. 7619 A

INDIA.—STRUCTURAL DRAUGHTSMAN.—Young unmarried MAN REQUIRED, with good experience of Bridge Work and Light Structural Work and sound knowledge of the theoretical side. Good opening for capable man with initiative.—Write, with details of training and experience, to Z. K. 903, c/o Deacon's, Leadenhall-street, London. 7626 A

EXPERIENCED DRAUGHTSMAN WANTED; Centrifugal Pump or Refrigerating Experience preferred.—Apply by letter to NINE ELMS IRON WORKS, Reading. 7612 A

SENIOR DRAUGHTSMAN REQUIRED for Estimating Department by Firm manufacturing Bridge, Roofing and Constructional Steel Work. Must be quick and accurate designer and accustomed to estimating. State age, experience, and salary required. —Address, 7616, The Engineer Office. 7616 A

STRUCTURAL DRAUGHTSMAN REQUIRED, capable of Designing and Detailing Roofs, Girders, Colliery Head Gears, &c. Must be rapid worker.—State age, experience, salary to NORTONS (Tividale), Limited, Tipton. 7594 A

WATER POWER.—The POSITION of CHIEF DRAUGHTSMAN in our office will become VACANT on 1st April next. Application will only be considered from parties with experience and capable of taking full responsibility for design of Pelton Wheels.—Apply by letter to JAMES GORDON and CO., Engineers and Contractors, Windsor House, Kingsway, W.C. 2. P5054 A

SITUATIONS WANTED

ADVERTISING.—Experienced ENGINEER-ADVERTISING MANAGER, at present in charge of publicity dept. of well-known firm, OPEN to CONSIDER advantageous CHANGE. Clear outlook on policy with sound knowledge of detail. Would demonstrate capabilities before engagement.—Address, P5077, The Engineer Office. P5077 B

A.M.I. MECH. E. REQUIRES Responsible POST on administration; 2½ years' training; excellent testimonials. Write for information.—Address, P5083, The Engineer Office. P5083 B

BLAST FURNACES.—ASSISTANT MANAGER or GENERAL FOREMAN, 17 years' practical experience, well accustomed maintenance work and yard traffic; willing to go abroad; good refs.—Address, P5063, The Engineer Office. P5063 B

BUYING ENGINEER.—The MANAGER of a Large Engineering Works Purchasing Dept., who has an exceptionally wide knowledge of the markets of the country, DESIRES to NEGOTIATE NEW APPOINTMENT.—Write, E. M. 618, c/o Deacon's, Leadenhall-street, E.C. 3. 7652 B

CIVIL ENGINEER, Age 29 Years. University graduate, ex-Service R.E., good worker, good references, REQUIRES POSITION with firm of Civil Engineers; at present engaged on public works.—Address, P5086, The Engineer Office. P5086 B

ENGINEER, B.Sc., Eight Years' Practical Experience, WANTS APPOINTMENT as Assistant to Commercial Engineer. Willing to accept low salary.—Address, P5066, The Engineer Office. P5066 B

ENGINEER (24), Poly. Educ., Good Draughtsman, DESIRES POST as Assistant to Mech. or Civil Engineer, home or abroad.—L. M., 4, St. John's-road, S.W. 9. P5080 B

ENGINEER (33), Mechanical and Electrical, Shop and drawing-office experience, SEEKS POSITION, maturing inventions, experimental or research work.—A., 49, Argyle-road, Ilford. P5049 B

ENGINEER (35), A.M.I.M.E., M.I.A.E., &c., Many years' experience works and business management, and with complete commercial experience, including sales organisation, experienced designer and with extensive knowledge of works accountancy, shortly relinquishing managing directorship, SEEKS responsible Managerial APPOINTMENT. Would entertain home, continental, or foreign representation. —Address, P4822, The Engineer Office. P4822 B

EUSTACE ARCHER, Civil Engineer, of 20 Years' standing (10 years in London), at present employed on important railway construction in Norway, SEEKS POSITION in Australia or New Zealand as Leading Engineer for location and construction of section or whole railway line. Excellent testimonials and college degree.—Reply, Box V. 99, National Advertising Service, 51, Ann's Chambers, Ludgate-hill, E.C. 4. 7343 B

EX-PATTERNMAKER SEEKS SITUATION in any drawing-office. Experience: 12 years pattmaking, 1½ years D.O. Age 31.—B. J. EDMUNDS, 47, Cottesmore-road, Lenton, Nottingham. P5070 B

FACTORY ORGANISER (49) DESIRES CHANGE, production control, cost and stores systems; thorough knowledge of scientific management; large experience, England and America; used to control. London or Midlands preferred.—Address, P5055, The Engineer Office. P5055 B

MECHANICAL ENGINEER (23), Studying for Inter. B.Sc., WANTS EMPLOYMENT, high-class manufacturing concern, with view to extending experience. Asp. fitter, junior in D.O.—J. PEARSON, 24, York-road, Brighton. P5064 B

MECHANICAL ENGINEER, with Good All-round general experience as foreman, cost clerk and manager, SEEKS responsible POST in any capacity, any district.—SNOAD, 36, York-road, Hitchin. P5082 B

QUALIFIED ENGINEER, with 20 Years' Wide experience, UNDERTAKES DESIGNING, DRAWING, and TRACING WORK of all descriptions.—Address, P5075, The Engineer Office. P5075 B

STRUCTURAL ENGINEERS.—Progressive Firm, desiring services of experienced engineer as chief engineer or works manager, should write advertiser, who SEEKS CHANGE with good prospects. At present assistant to chief engineer. Experienced all classes structural work, buildings, roofs, bridges, &c.; 15 years' shops, drawing-office, outside experience; used control staff, latest workshop and office methods for competitive production. Passed Assoc. M. Inst. C.E., 1910, B.Sc. (Eng.), London, A.C.G.I., Royal Engineer officer during war.—Address, P5038, The Engineer Office. P5038 B

SITUATIONS WANTED (continued)

POST REQUIRED by Energetic Man with 20 Years' experience foundry work, pattern-making, wood-working machinery; commercial experience, good organiser and manager.—Address, P5090, The Engineer Office. P5090 B

THOROUGHLY Practical ENGINEER SEEKS RE-EMPLOYMENT as Outdoor Erector or Resident Engineer, water power, steam, gas, oil engines, boilers, heating, pumps, and general concrete foundations and building lay-outs; can take entire charge; age 32, single, no home ties, go anywhere, home or abroad; excel. refs.—Address, P5091, The Engineer Office. P5091 B

YOUNG ENGINEER (22) SEEKS POSITION, Stud. Inst. C.E., qual. eng. aircraft, 7 years' premium apprenticeship, now expired, boilers, hydraulic engines. Would go abroad.—GREEN, Bourton-villa, Buckingham. P5092 B

CAPABLE JUN. DRAUGHTSMAN REQS. POST; student in mech. eng. at technical inst. 2 yrs., 3½ yrs. D.O. and works exp., air comp., cent. installations and I.C. eng.; ex. refs.—Address, P5079, The Engineer Office. P5079 B

DRAUGHTSMAN and ENGINEER, London, 14 years shops, 12 years office, all-round experience, including inventions and low-temperature carbonising; can take charge; moderate salary.—Address, P5098, The Engineer Office. P5098 B

DRAUGHTSMAN, Catalogues, Illustrative, Advertising, Patent Drawings, first-class man, SEEKS CHANGE.—Address, P5095, The Engineer Office. P5095 B

DRAUGHTSMAN (Junior), 5½ Years' Practical workshop experience (6 years apprentice fitting, machine shop and foundry), 1½ years drawing-office, working drawings, general arrangements, tracings and printing. Salary according to prospects of advancement.—GIBSON, 90, Church-road, Teddington, Middlesex. P5078 B

DRAUGHTSMAN (21) DESIRES POST at Home or abroad; D.O. and workshop experience; excellent references.—W., 10, Cresswell-road, Twickenham. P5061 B

DRAUGHTSMAN, 6 Years Shop, 2 Years D.O., I.C.S. student; present engaged; any district. —Address, P5044, The Engineer Office. P5044 B

DRAUGHTSMAN-MECH. ENGINEER (26) DESIRES D.O. or other POST. Exp. marine machinery, steam, heavy oil engines, consulting work. —Address, P5096, The Engineer Office. P5096 B

DRAUGHTSMAN (23) SEEKS POST in or Near London. Sound technical training and excellent testimonials. Interview solicited.—Address, P5057, The Engineer Office. P5057 B

DRAWING-OFFICE ASSISTANT. Good All-round man. Details, tracing and general D.O. routine. —Address, P5094, The Engineer Office. P5094 B

MACHINE SHOP FOREMAN or CHARGE HAND SEEKS POSITION; practical man on up-to-date machines, well up in general and motor work, and would undertake toolmaking; 18 years' experience, age 34.—Address, P. H. H., 150, Upper-street, London, N. 1. P5093 B

BOILERMAKER, Recently Returned from the Far East, experience constructional and ship work and general engineering, has held responsible positions, and capable of taking full charge, DESIRES POSITION, home or abroad; excellent references.—Address, P5060, The Engineer Office. P5060 B

POWER-HOUSE FITTER REQUIRES SITUATION, either at home or abroad. Six years' first-class experience with heavy turbine manufacturers; age 22 years; good education.—Address, P5067, The Engineer Office. P5067 B

ENGINEER MECHANIC (42) SEEKS JOB, Installation and charge of plant abroad; experienced gas, steam; speaks Spanish; used foreign labour.—Address, 7588, The Engineer Office. 7588 B

PARTNERSHIPS

ENGINEERING PARTNERSHIPS AND BUSINESSES.

Wheatley Kirk, Price & Co.

46, Watling Street, London, E.C. 4.

Established seventy years.

SECRETARY-DIRECTOR REQUIRED, Full-time occupation, preference to one with knowledge of machinery. Investment £2000, established manufacturing company, capital £40,000, with extensive freehold factory near London employing large number of workmen, salary £500 p.a. plus dividends. Open to solicitors' and accountants' investigation.—Write, Box 1684, Sell's, 167, Fleet-street, E.C. 4. 7010 C

£1400 Per Annum as MANAGING DIRECTOR; £5000 required; £4000 covered by mortgage. Engineers and metal workers. Principals only.—Write, Box 68, c/o Harman Service, 170, Strand, London, W.C. 2. 7032 C

EDUCATIONAL

CORRESPONDENCE COURSES for B.Sc., Inst. C.E., I. Mech. E., and all ENGINEERING EXAMINATIONS. Special Courses and Single Subjects. Personal Tuition.—Mr. TREVOR W. PHILLIPS, B.Sc. (Hons.), Assoc. M. Inst. C.E., M.R.S.I., &c., 5-10, Trafford Chambers, 58, South John-street, Liverpool. Ex.

HOME STUDENTS, London Matric., A.M.I.C.E., and all Institution Exams. Really individual tuition by post at very low fees. Send stamp for particulars.—CONSULTUTORS, 60, Abingdon-road, Kensington, London, W. P5089 B

INST. C.E., Inst. Mech. E., B.Sc., and all ENGINEERING EXAMINATIONS.—Mr. G. P. KNOWLES, M.E.E., A.M. Inst. C.E., &c., personally PREPARES CANDIDATES, either orally or by correspondence. Thousands of successes during the past sixteen years. Courses can be commenced at any time.—39, Victoria-street, Westminster, S.W. Telephone No., Victoria 4780. Ex.

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MISCELLANEOUS

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For continuation of For Sale Advertisements, see page iii.

Proposed Great Lakes - Atlantic Canal.

A DEEP-WATER navigable connection between the Atlantic Ocean and the American inland seas known as the "Great Lakes," so that ocean steamers may serve the important American and Canadian cities and ports on the lakes, is a bold project which has been advocated at various times during the past fifty years, and which is now receiving active consideration in both the United States and Canada. Its purpose is the development of commerce by facilitating and cheapening the interchange of goods, and especially of distributing the grain shipments from the vast fields of the American and Canadian Northwest.

This group of lakes, with its connection to the Atlantic Ocean by way of the St. Lawrence River, is shown in Fig. 1. At the head of the chain of lakes, and by far the largest of the group, is Lake Superior, 412 miles long and 170 miles wide, with an area of 31,000 square miles. Its surface is 602ft. above sea level, and the maximum depth is 1008ft. Through the St. Mary's River, with a fall of 20ft., mainly at a series of rapids, the water flows into Lake Huron, which is about 250 miles long and 190 miles wide, with an area of 22,000 square miles, including the large branch known as Georgian Bay. Its surface is 582ft. above sea level, and its depth is from 200ft. to 750ft.

Lake Michigan, 300 miles long and 80 miles wide, with an area of 21,730 square miles, opens from the head of Lake Huron through the Straits of Mackinac, the two lakes lying nearly parallel, and having the same surface level. Lake Michigan has a depth of about 870ft. On its western side is the land-locked Green Bay, 120 miles long and 50 miles wide. At the south end of the lake the Chicago drainage canal connects with a tributary of the river Mississippi, and it is proposed to develop it into a navigable channel with 14ft. of water over the lock sills.

From the south or lower end of Lake Huron there is a channel known as the St. Clair River, which opens out into the small Lake St. Clair. Beyond this another channel—the Detroit River—leads into Lake Erie. Lake Erie is some 246 miles long and nearly 60 miles wide, with a surface area of 9900 square miles. Its surface is 573ft. above sea level, and its water is relatively shallow, with a depth of only 100ft. to 200ft. Through the Niagara River and over the great Niagara Falls the water flows into Lake Ontario, the last of the group, with its surface 247ft. above sea level. It is nearly 200 miles long and 55 miles wide, with an area of 7104 square miles and a maximum depth of 738ft.

The total area of the Great Lakes and their connecting rivers or channels is nearly 100,000 square miles, and their combined shore line has a length of nearly 5400 miles. From the head of the lakes to the Atlantic Ocean the distance is nearly 2000 miles, and the length of the St. Lawrence River from Lake Ontario to the ocean is about 700 miles. Montreal is at the head of ocean navigation, 180 miles below Lake Ontario and 160 miles above Quebec. Beyond Quebec the river widens into a great estuary 250 miles long, with a width of 35 miles where it enters the Gulf of St. Lawrence.

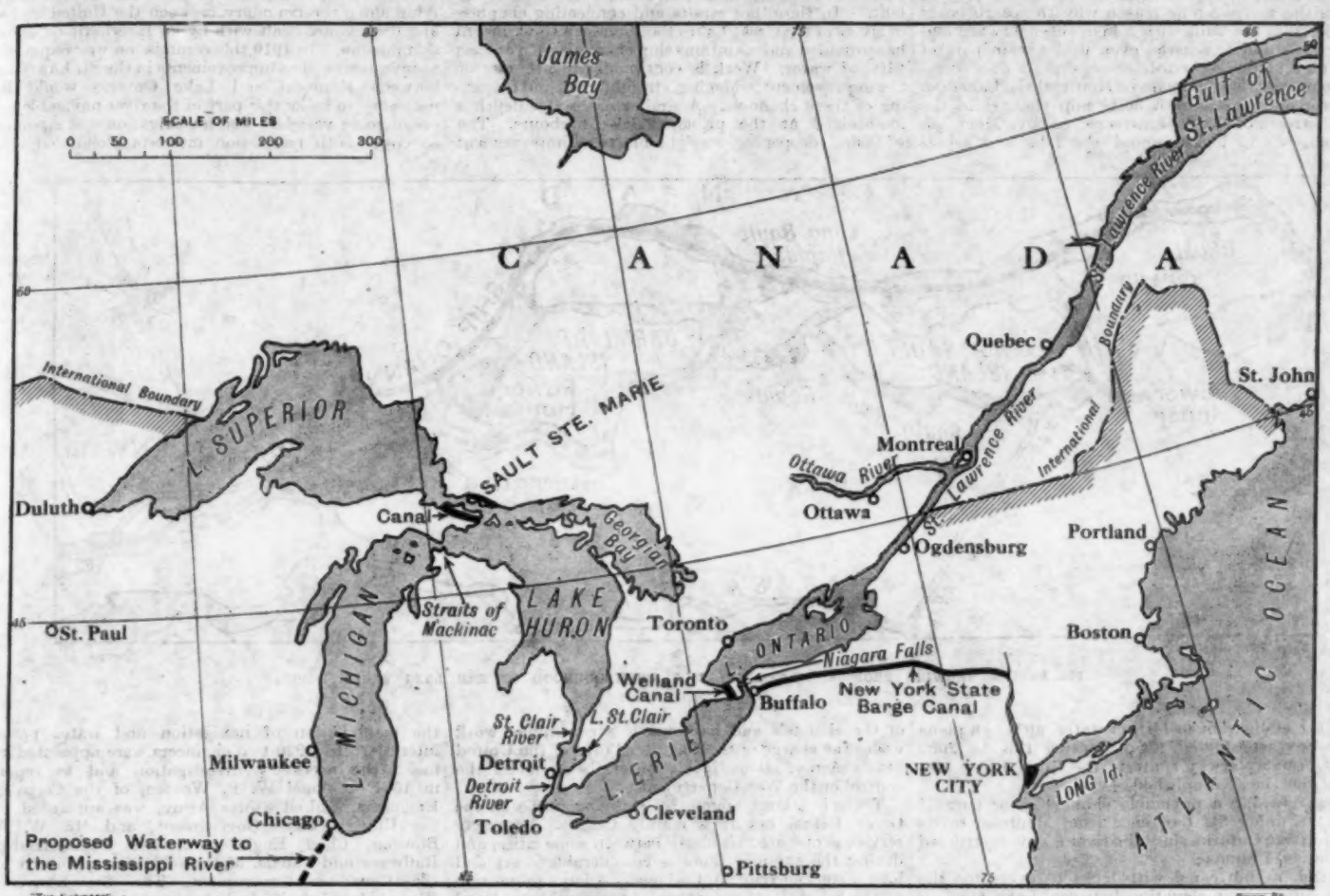

FIG. 1—MAP SHOWING THE GREAT LAKES OF NORTH AMERICA

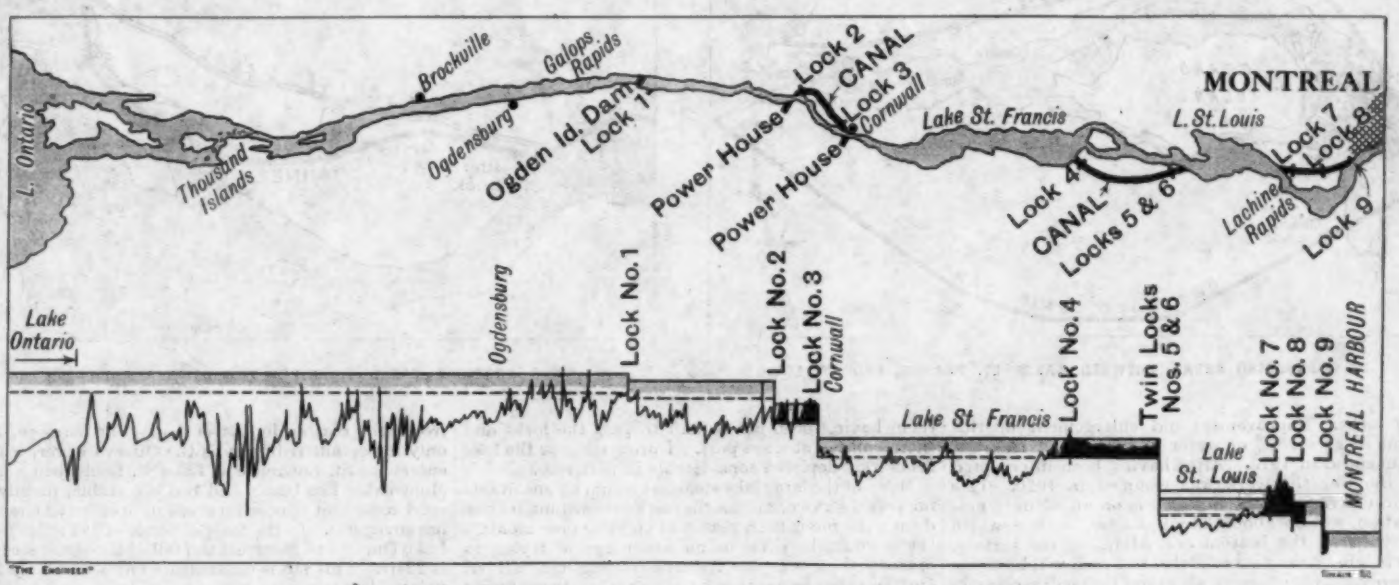

FIG. 2—PROPOSED NAVIGABLE CHANNEL BETWEEN LAKE ONTARIO AND MONTREAL

The lakes are subject to violent storms, with waves which are steeper but shorter than ocean waves. Therefore, the hull stresses are less severe in lake steamers, but the deck structures and fittings must be built to withstand the blows delivered by waves breaking on the deck. With limited sea room, the lake steamers cannot so readily favour themselves by changing course in heavy storms, but must hold pretty closely to their courses. This necessity of facing the waves is one reason why the cargo boats on the lakes are built with a high sheer forward and high bows and forecastle, even if the main part of the hull is of low freeboard.

From the Atlantic Ocean to Montreal the Canadian Government maintains a 30ft. ship channel in the broad stream of the St. Lawrence. Above Montreal, the canals and locks around the falls and rapids past the rapids in the St. Mary's River, which is the strait connecting Lakes Superior and Huron. Here there is a single lift of 20ft. Owing to the heavy traffic through this channel, known colloquially as "The Soo," the American canal has four parallel locks, two of these being of recent construction, each with a lock chamber 1350ft. by 80ft., to allow of locking two or three vessels at a time. On the Canadian side the canal has a single lock, 900ft. by 60ft. In the other straits and connecting channels or rivers of the Great Lakes the American Government has provided and maintains ship channels with at least 21ft. of water. Work is continually in progress on the improvement, widening, straightening and deepening of these channels. A similar or greater depth is maintained at the principal lake harbours. The widening, deepening, straightening and improvement between Montreal and Lake Ontario. The upper St. Lawrence between these points has a length of about 182 miles—see Fig. 2. Certain passenger steamers navigate the open river in summer—in a down-stream direction—by "running the rapids." For freight steamers and all up-stream traffic the Canadian Government has a series of canals and locks, with 14ft. depth of water. International problems of water power and navigation on waters lying along the boundary between the United States and Canada are dealt with by an International Joint Commission. In 1919 this commission was requested to investigate what improvements in the St. Lawrence between Montreal and Lake Ontario would be necessary to make this part of the river navigable for ocean-going vessels. The investigation was specified to cover both navigation interests alone and also

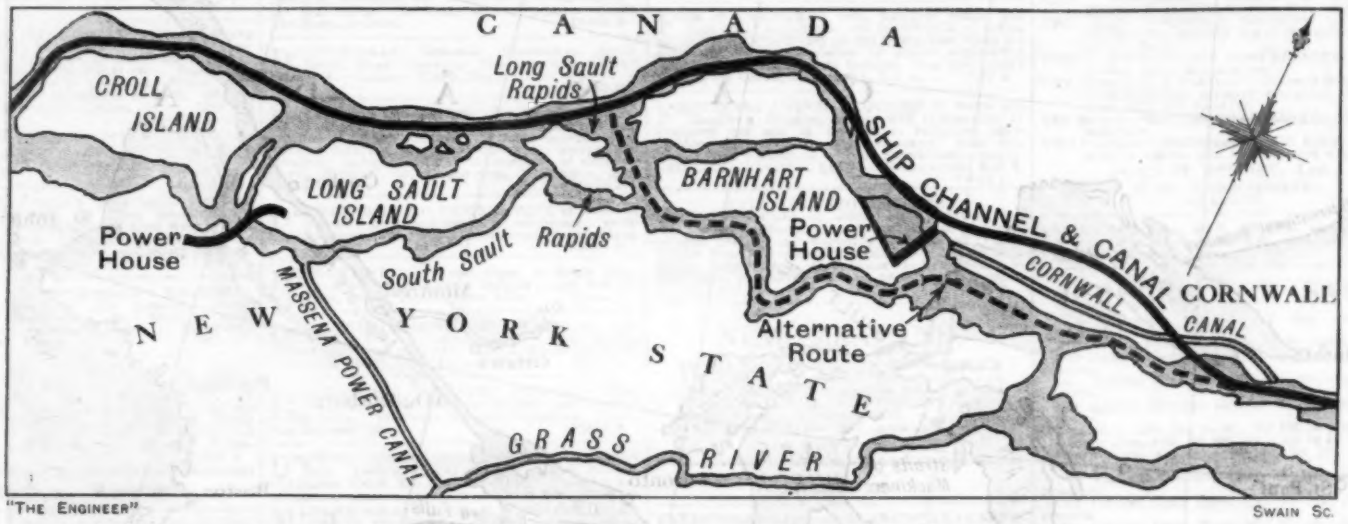

FIG. 3—PLAN SHOWING PROPOSED WORKS IN THE NEIGHBOURHOOD OF THE LONG SAULT RAPIDS

limit the navigation to 14ft. of water, although plans have been considered for increasing this to 20ft. For a deep waterway route to the Great Lakes two works must be accomplished :—

First, opening a navigable channel in or parallel with the upper St. Lawrence from Montreal to its head in Lake Ontario, since the river is now obstructed by a series of rapids ;

Second, a ship canal with locks to overcome the 326ft. difference in elevation between Lake Ontario and Lake Erie, a difference which the water overcomes mainly by the great drop at the Niagara Falls.

This second work, however, is well advanced towards accomplishment, since a ship canal has been undertaken by the Canadian Government. For many years the old Welland Canal has afforded a connection between the two lakes, with 14ft. of water, the difference in elevation being overcome by twenty-five locks. Improvement and enlargement of this canal to give 25ft. of water over the lock sills was commenced in 1913. After having been interrupted by the war the work was resumed in 1920. This improved canal, part of which is on an entirely new location, will be about 25 miles long, with a width of 200ft. on the bottom and 310ft. on the surface. There will be only seven locks, but each will have the exceptional lift of nearly 47ft., and they will accommodate vessels up to 800ft. in length. Although the draught at present is being made 25ft., all structures are built to provide for a future depth of 30ft. of water.

Lake Navigation.

Above Niagara Falls and through Lakes Erie, Huron, Michigan and Superior, there is deep water navigation, broken only by the canals and locks at Sault Sainte Marie. These works carry shipping of the channels and harbours is a continuing work under the charge of the Engineer Corps of the United States Army, all navigable waters being under the control of the War Department.

There is a large amount of shipping traffic on the Great Lakes, but it is mainly freight. Passenger service is operated regularly between some cities, and during the summer there is considerable short and long distance excursion business. A large proportion of the freight traffic consists of ore southbound and coal northbound. Some of the modern cargo boats are over 600ft. in length. Cargo steamers of the smaller class have been run directly from Chicago to European ports, but, with the present series of small canals and numerous locks to pass the rapids of the St. Lawrence, the inland portion of the voyage is slow and costly. Larger ships empty, have been passed from the lakes to the sea in this way, some of them having been cut in half to pass the locks and then reunited at a sea port. During the war the lake fleets were depleted considerably in that way.

Many of the large lake steamers would be unsuitable for ocean service, and as they are in constant service during the navigation season of eight or nine months, there would be little or no advantage in trying to operate them on the Atlantic during the winter. On the other hand, it is not likely that there would be any desire for, or economy in, operating the largest class of ocean liners on the Great Lakes. The advocates of the deep waterway, however, argue that the majority of ocean freight is carried in ships of less than 10,000 tons, and that these could readily navigate the lakes and their connecting rivers or straits.

Navigation of the Upper St. Lawrence.

This brings us then to the establishment of the missing link of a deep-water navigable channel

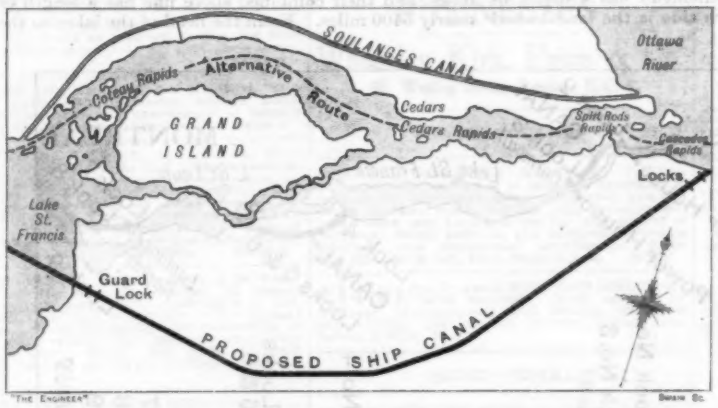

FIG. 4—PROPOSED CANAL BETWEEN LAKES ST. FRANCIS AND ST. LOUIS

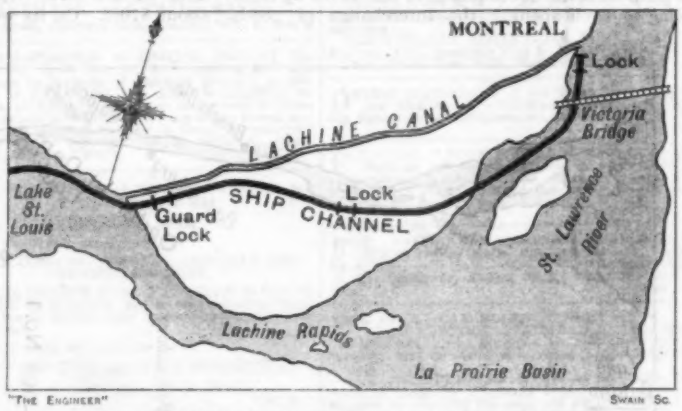

FIG. 5—PROPOSED CANAL TO AVOID THE LACHINE RAPIDS

five locks. Improvement and enlargement of this canal to give 25ft. of water over the lock sills was commenced in 1913. After having been interrupted by the war the work was resumed in 1920. This improved canal, part of which is on an entirely new location, will be about 25 miles long, with a width of 200ft. on the bottom and 310ft. on the surface. There will be only seven locks, but each will have the exceptional lift of nearly 47ft., and they will accommodate vessels up to 800ft. in length. Although the draught at present is being made 25ft., all structures are built to provide for a future depth of 30ft. of water.

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Above Niagara Falls and through Lakes Erie, Huron, Michigan and Superior, there is deep water navigation, broken only by the canals and locks at Sault Sainte Marie. These works carry shipping

Navigation of the Upper St. Lawrence.

This brings us then to the establishment of the missing link of a deep-water navigable channel

free from matter in suspension. Furthermore, the only important tributary is the Ottawa River, which enters the St. Lawrence at Lake St. Louis, just above Montreal. The banks and bed are stable, mainly in solid rock, and oppose no great difficulties to channel improvement. In the total distance of 182 miles from Lake Ontario to Montreal the fall of the water surface is 224ft. This fall is concentrated at a relatively few points, between which there are long reaches with depth and current suitable for open navigation.

The following description of the characteristics of this part of the river is condensed from a paper read before the Western Society of Engineers by Major J. C. H. Lee, Corps of Engineers, United States Army. From Lake Ontario to Ogdensburg, New York, a distance of 62 miles, the fall is less than 1ft., and the velocity is low. The main channel has a depth ranging from 40ft. to 120ft., and in general its width is over 500ft. though through the Thousand

the combination of navigation and water power interests. In 1920 two engineers were appointed to make the necessary investigation and to report in 1921. Colonel W. P. Wooten, of the Corps of Engineers, United States Army, was appointed by the United States Government, and Mr. W. A. Bowden, Chief Engineer of the Department of Railways and Canals, of Canada, was appointed by the Canadian Government. The St. Lawrence River below Lake Ontario has a remarkably uniform flow of 200,000 to 280,000 cubic feet per second. This flow is governed by the elevation of water in Lake Ontario, which has an extreme fluctuation of only about 5ft. and a much smaller annual fluctuation. The maximum flow record is 300,000 cubic feet per second, and the minimum—with ice choking the channels—is 186,000. With a long period of sedimentation in the lake the water is exceptionally clear and

Islands the width is reduced to about 400ft. From Ogdensburg, on the American side, to the head of Lake St. Francis, near Cornwall, on the Canadian side, the distance is 54 miles with a total fall of about 90ft. This fall is distributed mainly between the Galops Rapids, 10ft.; the Rapide Plat, 12ft.; and the Long Sault Rapids, 40ft. Major Lee estimated that a hydro-electric plant near Cornwall could develop about 1,750,000 horse-power, and that in the entire 182 miles there could be developed 4,500,000 horse-power out of a theoretical total of 6,000,000 horse-power. The broad stretch of river known as Lake St. Francis is 28 miles in length, with a width of 4 to 5 miles. From Lake St. Francis to the head of Lake St. Louis, a distance of 15 miles, there is a fall of 80ft., divided between the Coteau Rapids, the Cedar Rapids, the Split Rock Rapids and the Cascade Rapids. The Soulanges Canal provides 14ft. navigation past this group of rapids. Lake St. Louis is about 15 miles long and 5 to 6 miles in width, but is relatively shallow. Finally, from Lake St. Louis there is a 10 mile stretch of river with a fall of 60ft. at the Lachine Rapids, below which the river widens out into the broad La Prairie Basin, just above the city. The Lachine Canal provides for passage around the rapids and terminates in a dock on the water front of Montreal.

Plans for St. Lawrence Improvement.

A summary of the general conclusions presented in the joint report of Colonel Wooten and Mr. Bowden shows that the physical conditions are favourable for improvements for navigation which will be permanent and will have low cost for upkeep or maintenance. Development of nearly all the potential power in the river—approximately 4,100,000 horse-power—can be carried out as co-ordinate parts of the improvement for navigation. But the immediate or simultaneous development of such a vast amount of power is not a sound economic procedure. The project submitted is designed to provide channels with a minimum depth of 25ft. and ample navigable width all the way from Lake Ontario to Montreal. These channels may be deepened subsequently to 30ft. without destroying any of the present permanent works. The project includes the incidental development of the first of a series of hydro-electric power plants, which are together to be capable of generating a total of 1,460,000 net horse-power delivered at the switchboard. It provides also for future development of remaining power in the river, which work will not affect or be hindered by the improvement for navigation.

This St. Lawrence River canalisation project is shown clearly in Fig. 2, in plan and in longitudinal section. It will be seen that there are three stretches of canal. These aggregate 34 miles, but it is expected that this may be reduced to 24 miles when the final working plans are made. There are nine locks, but two of them are guard locks at the upper end of canal stretches, and normally they would be left open. This navigation and power development work may be reviewed briefly as follows:—

First Section.—From Lake Ontario to a point just below or east of Ogdensburg—Fig. 2—the river is mainly deep and wide, as already described, with a fall of only 1ft. in 65 miles. The improvement work would include the widening and straightening of the ship channel and the removal of shoals. This would cost about £25,000.

Second Section.—From Chimney Point, just below Ogdensburg, to the head of Lake St. Francis the distance is 48 miles, with four rapids giving a fall of 92ft. The improvement would consist of a series of dams at the Long Sault Rapid—Fig. 3—to raise the water level to elevation 231ft. above sea level. Also a dam higher up, at Ogden Island—Fig. 1—to raise the level to that of Lake Ontario minus the natural fall of the river. This dam, therefore, could regulate the level of Lake Ontario. The first lock is to be at the Ogden Island dam, and at the lower dam there will be a short canal with two locks dropping from elevation 231 in the pool to elevation 152 in Lake St. Francis. A power plant would be situated at the head of the South Sault channel, near the upper end of Long Sault Island. The main power plant, however, would be below the rapids, near the lower end of Barnhart Island.

The Ogden Island dam is planned as a concrete structure with a 600ft. weir or spillway, a Stoney sluice gate section and a submerged gate section. The Long Sault dam, also of concrete, is to be 3900ft. long, with a weir and control gates. Another dam with power-house would be at the head of the South Sault channel. The Barnhart Island power plant, with 52 units spaced 65ft. between centres, will be a concrete structure about 3800ft. long, flanked by earth embankments having concrete core walls carried to rock.

Third Section.—Through Lake St. Francis, about 28 miles, the only improvement necessary would be dredging at certain points to give 25ft. of water throughout a channel width of 450ft. This would cost about £290,000.

Fourth Section.—This 16-mile stretch connecting Lake St. Francis with Lake St. Louis has a fall of about 83ft. in the rapids already mentioned. This stretch of the work is shown in Fig. 4. The engineers recommend the construction of a canal south of the river, with a guard lock of 3ft. lift at the upper end and a parallel or twin set of double locks at the lower end, beyond which the canal would open into the river. For 25ft. of water and a minimum bottom width of 220ft., and with works so built as to permit of future widening to 400ft. and deepening to 30ft., the cost would be about £9,150,000. The future widening and deepening would cost about £77,750.

An alternative plan, which involves omission of the power development on Sec. 2, provides for damming the river near the town of Cedars in order to maintain the level of Lake St. Francis—elevation 152—to this dam. Navigation and water power canals would be built from above the dam to Lake St. Louis, with locks and a power plant for the development of 1,560,000 horse-power. For this alternative scheme the estimated cost is £12,430,000 for navigation works, and £31,117,000 for the power development. As compared with the recommended plan, the cost of power development would be less, but the cost of navigation improvement would be greater, while the ultimate economy would be in favour of the recommended plan.

Fifth Section.—For the final stretch, connecting Lake St. Louis with the La Prairie basin of the river, above Montreal, and avoiding the Lachine Rapids, with a fall of 45ft., the plan recommended is the construction of a canal on the north side of the river. This canal would have a lock of 26ft. lift at its entrance below the Victoria Bridge, a second lock near the middle, with 18ft. lift, and a guard lock at the upper end for the remainder of the lift. This Montreal section of the work is shown in Fig. 5.

In this great river canalisation project for the extension of ocean shipping the locks are to be similar to those on the new Welland Canal: 860ft. long between gate quoins and 80ft. wide between the side walls. For canal prisms the bottom width will be 220ft. for a 25ft. depth of water or 200ft. for the future 30ft. depth. One bank will be placed far enough from the centre line to permit of the future widening to 400ft. In the open river the channels are to have a minimum width of 450ft. through the broad reaches or lakes, and 600ft. to 1000ft. in sections in which a reduction in stream velocity is necessary. For construction work, the uniform flow of the river is in one respect a disadvantage, since there are no low-water periods to facilitate the prosecution of the work. On the other hand, there are no heavy flood flows to be feared, and there is the advantage that the heavy work is grouped at relatively few points and in rock formation. Ice conditions, both as regards floating and anchor ice, will constitute difficulties in the design, construction and operation of the works. Particulars of the works and cost involved in the present project and its future enlargement are given in the accompanying table. An estimated cost of £63,200,000 is presented in the report for improvements recommended to give a 25ft. depth of water, with provision for a future increase to 30ft. without interference with navigation. This estimate includes the cost of hydro-electric development of 1,500,000 horse-power. For operation, maintenance and depreciation of the works there would be an annual cost of £640,500, a little more than 50 per cent. of this being incurred by the hydro-electric plants. The future cost of increasing the navigable depth to 30ft. is estimated at £4,500,000.

Proposed Canalisation of the Upper St. Lawrence River.

	Section 1. Lake Ontario to Chimney Point.	Section 2. Chimney Point to St. Regis Island.	Section 3. St. Regis Island to Lake St. Francis.	Section 4. Lake St. Francis to Lake St. Louis.	Section 5. Lake St. Louis to Montreal.	Total. Lake Ontario to Montreal.
Length, canal, miles	—	7¼	—	13¼	13	34
Length, river, miles	65	40¾	28	2¼	12	148
Length, total, miles	66	48	28	16	25	182
Difference in elevation, feet	1	92	3	83	45	224
Number of locks	—	3	—	2 (1 guard)	2 (1 guard)	9 (2 guard)
Hydro-electric development, horse-power	—	1,464,000	—	—	—	1,464,000
Estimated cost for 25ft. depth	£25,000	£40,000,000	£280,000	£9,150,000	£14,000,000	£63,435,000
Annual maintenance cost	£5,000	£440,500	£7,500	£100,000	£90,000	£643,000
Additional cost for 30ft. depth	—	£317,500	£165,500	£772,500	£3,236,500	£4,800,000
Possible hydro-electric development, horse-power	—	180,000	—	1,560,000	860,000	2,600,000

Although power development of about 4,100,000 horse-power is practicable, the engineers point out that it would not be wise to incur the cost of this entire development during the first stage of the project, since there is no sufficient market now available. The economic plan of procedure is to improve for navigation alone those reaches in which side canals and locks can be used, and in which the present improvement will not interfere with plans for future power development. In that part of the river where navigation can best be improved by means of dams and locks in the channel, it would be wise to provide for the development of power obtainable as a result of heads created by the dams.

If the proposed works are carried on simultaneously, and with funds made available as fast as needed, it is expected that the entire improvement can be completed and the Upper St. Lawrence route opened to ocean steamers within eight years from the time of its commencement.

British Industries Fair at Birmingham.

No. II.*

We continue below our account of the exhibits at the Birmingham Section of the British Industries Fair.

Cotton Driving Ropes.

William Kenyon and Sons, Limited, of Chapel Field Works, Dukinfield, had two stands, on which there were shown a large variety of cotton ropes and devices connected with the transmission of power by ropes, besides boiler and pipe coverings and sheet metal work. A model, lent by C. A. Parsons and Co., illustrated a large cotton mill drive for which the ropes were made at the Chapel Field Works. It comprises a 2300 brake horse-power turbine connected with thirteen countershafts by means of 1¾in. diameter cotton rope, of which over 5 tons in weight was required. The rope speed is 1970ft. per minute, and we were told that only 30s. has been expended on the upkeep of the ropes since they were installed in 1914, while it is probable that the most severely stressed

FIG. 10—THE WEILDING CLUTCH

of the ropes will continue at work for several years more.

For the purposes of driving ring spinning frames and similar machines this firm makes the special form of clutch illustrated by Fig. 10. The clutch is of the coned type, and is lined with Ferodo, so that it can be allowed to slip for appreciable periods of time without damage. The engaging gear is so devised that there is no end thrust on the shaft either when the clutch is in or out of action. It is claimed for these clutches that they provide a more even turning moment than is possible with a belt drive, while they naturally permit any machine to which they are fitted being started or stopped indefinitely. A new type of gallows bracket for leading the driving ropes from the main shaft to spinning frames was also exhibited on this stand. It is provided with two grooved guide pulleys mounted on short axles, which have palms formed on their inner ends at an oblique angle to their axes. Thus, by turning the axles with respect to the frame to which they are bolted, the plane of rotation of the wheels can be so altered as to guide the rope in the required direction. A screw gear is provided for taking up any slack in the rope, and a bolt is used

* No. I. appeared March 3rd.

for clamping the frame in position when it has been set. These gallows brackets are noteworthy on account of the small amount of machining which they require in manufacture. The castings are so nicely made that practically the only machining done on them is the boring of the wheels and turning the axles. The rope grooves on the pulleys are finished by grinding.

Air Filters and Nail-making Machines.

Two quite distinct classes of machinery were being exhibited by William Grice and Sons, Limited, of Fazeley-street, Birmingham. On one side of the stand there were several machines at work making rivets and nails from cold rods or wire, while at the other end there was an example of the same company's air filters. This filter, of which we give a sectional drawing in Fig. 11, was originally designed

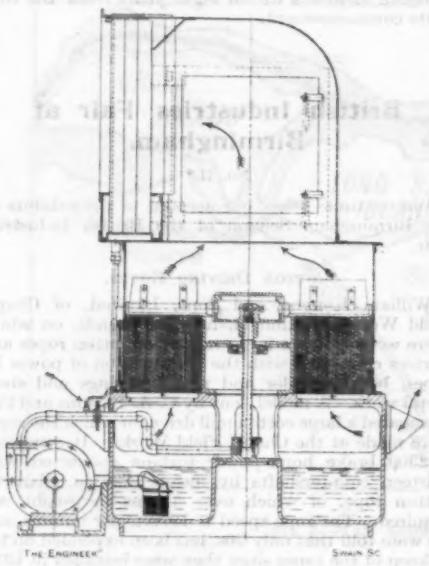


FIG. 11—GRICE AIR FILTER

for taking the dust out of air used for cooling electrical generators, but could naturally be used for a variety of other purposes in which a large volume of clean air is required. As is shown by the arrows on the drawing, the air enters at the bottom of the filter, and is drawn up through a nest of closely spaced plates, which are kept moist by a falling shower of water. Any dust in the air is caught by the water and is washed away into the base of the filter. The filter plates are scroll-shaped in plan, and are so closely spaced that in a 77in. unit, which will handle 25,000 cubic feet of air per minute, there are 3500 superficial feet of wetted surface in contact with the air. The water for moistening the plates is taken from the base of the filter by a pump and delivered to a set of rotary spraying arms through their hollow shaft. The arms are mounted on a ball bearing, and are provided with

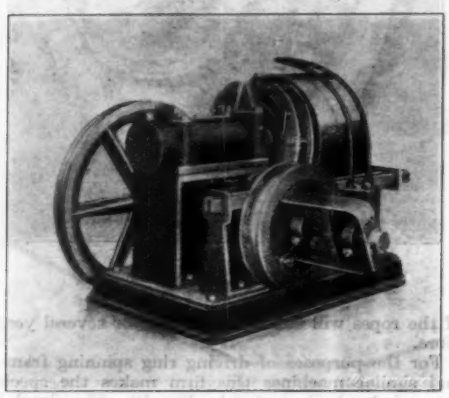


FIG. 12—LIFT GEAR—HOLT AND WILLETTS

vanes against which the current of air reacts and thus turns them at a speed corresponding with the draught passing. On the delivery branch of the pump there is a pressure gauge which indicates the fact if the spray holes in the arms get choked up, while there is a glass window so that the sprays can be seen at work. In the event of an arm getting choked up, it is a simple matter to stop it as it passes by, to unscrew a cap on the end, and to clean it out with a brush or stick. The air passing away at the top of the filter is saturated with water vapour, and a set of eliminator plates is arranged at the outlet to remove any free moisture. The water caught by these plates is drained back to the base. The pump requires only about 1½ horse-power to drive it. We were very favourably impressed with the workmanship of the casing and trunking of this filter, which is made of heavy gauge sheet, welded at the joints by means of the blowpipe and galvanised all over after welding.

Cranes and Lifts.

Messrs. Holt and Willetts, of Cradley Heath, had a quantity of lifting apparatus, among which was a belt-driven lift gear—shown in Fig. 12—designed to take the place of the crude makeshift rigs so often used in warehouses. It is intended for taking loads up to some 20 cwt. at a speed of 50ft. per minute, and is driven by open and crossed belts. The belts normally run on loose pulleys, but either one can be brought on to the central fixed pulley by the striking gear, which is operated by the hand rope running down the lift well. The cam plate connected with the rope wheel that is used to move the striking bars is so formed that there is a free position between the "up" and the "down" positions, and the bars have tappets for taking off the brake before either belt is moved on to the fixed pulley. A worm gear is used to reduce the speed of the driving shaft, and there is a ball bearing to take the end thrust. There were several other hoisting gears on the stand, including an electric friction hoist, direct-coupled with a totally enclosed electric motor. These hoists are made in six sizes to lift weights from 2½ cwt. to 20 cwt. at speeds varying from 60ft. to 120ft. per minute, and are controlled by a hand rope from any convenient position—usually near the door—enabling the operator to have the load in full view. The brake is applied automatically when the hand rope is let go. There was also an electric overhead travelling crab, suitable for a double girder electric overhead travelling crane, capable of lifting 3 tons at a speed of 25ft. per minute, and travelling along the crane bridge at 75ft. per minute. This crab was equipped with two alternating-current motors and a self-sustaining brake. An electric lifting and travelling pulley block, capable of lifting 1 ton at 20ft. per minute, and travelling along the bottom flanges of a R. S. joist overhead track, was also shown. The whole of the gear is machine-cut, pinions being of mild steel, and an adjustable mechanical brake is fitted which is applied by the load. The braking power is thus in exact proportion to the load being lifted.

Pumps and Steam Hammers.

John Cochrane (Barrhead), Limited, of Barrhead, near Glasgow, was showing the centrifugal pump illustrated in Fig. 13, some reciprocating pumps for oil and for boiler feeding, a motor-driven pneumatic forging hammer, and a steam hammer. The centrifugal pump is of the single-stage type with 6in. branches. It is coupled directly to an electric motor, and is capable of dealing with 700 gallons of water per minute against a total head of 150ft. The chief feature about the steam hammer is the extension of the piston-rod through the top cylinder cover. The arrangement naturally improves the guiding of the tup, and has the advantage, according to the makers, of reducing the steam consumption. Less steam will obviously be required to fill the space above the piston than would be needed if there were no tail rod, and

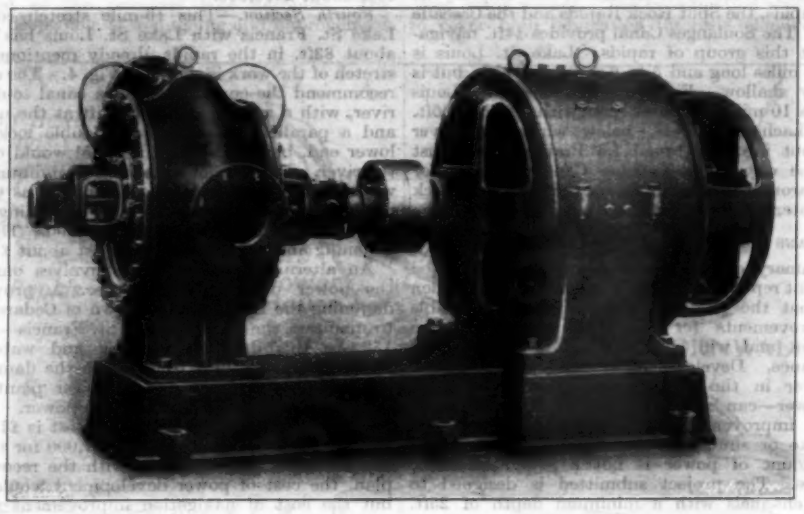


FIG. 13—COCHRANE SINGLE-STAGE CENTRIFUGAL PUMP

it is claimed that the greater falling weight compensates for the reduced area subjected to the steam pressure. A special form of hollow piston valve is fitted to these hammers, and it is so arranged that part of the exhaust, at the end of the downward stroke, is admitted below the piston and assists in starting the upward stroke. The results of some tests which we have seen go to prove that an ordinary steam hammer will, after conversion to the new system, work faster and with considerably less steam than before alteration. These hammers are made in several sizes, ranging from 3 cwt. up to 7½ cwt., and with cylinders 9in. by 20in. up to 13in. by 26in.

Tool Room Equipment.

The stand of the Brooke Tool Manufacturing Company, Limited, of Warwick-road, Greet, Birmingham, was devoted entirely to tools and tool room equipment, from inserted tooth milling cutters weighing several hundredweight to little pieces of high-speed steel for lathe-turning tools. The teeth of the milling cutters are very much like a Woodruffe key in shape, and their seatings are, in fact, cut with a Woodruffe cutter. A conical wedge is used to hold the cutter in position, and the set screw which tightens up the wedge at the same time presses the cutter down on to its bed. The result is a very rigid construction which enables these cutters to stand up to heavy feeds. Besides a great variety of taps and dies, drills and so forth, there was on this stand the little tap grinding machine shown in Fig. 14, which has only just been brought out. A cup-shaped grinding wheel, which is mounted on a hardened

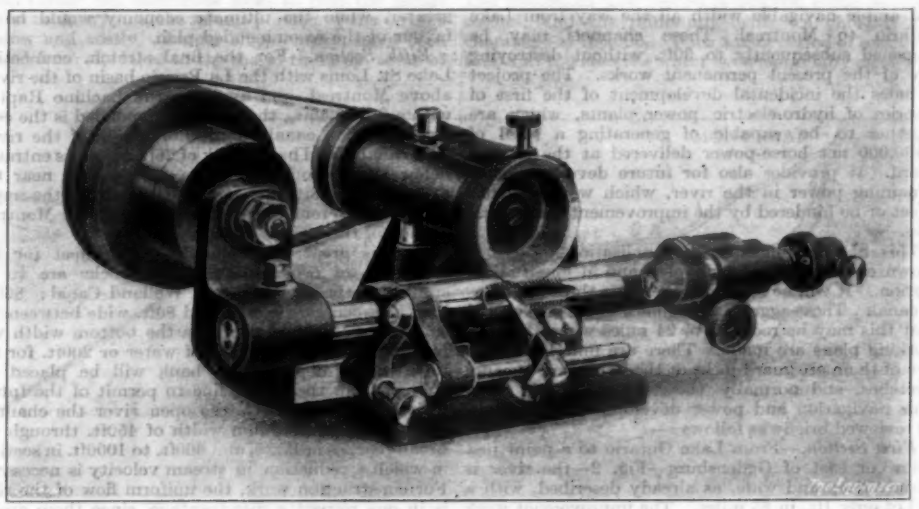


FIG. 14—THE BROOKE TAP GRINDING MACHINE

steel spindle running in a phosphor-bronze bush is used. The tap, or similar tool, to be ground is held between centres in a carriage provided with adjustments to regulate the cut. The carriage slides on a bar set transversely to the wheel spindle, and is fed across the face of the wheel by hand. It is a nicely made little machine, and, considering the variety of uses to which it could be put, is well worth the price asked for it. Its capacity is up to 1¼in. diameter.

HIGH-SPEED RAM PUMPS.

Lee, Howl and Co., Limited, of Tipton, were

FIG. 15—HIGH-SPEED PUMP—LEE, HOWL

showing a great variety of pumps, ranging from little semi-rotary hand pumps up to large sets for boiler feeding and mining work. There was also the little pump shown in Fig. 15 at work, driven by belt from an electric motor, with a light jockey pulley to maintain the tension in the belt. The remarkable feature about the pump was that it worked quite quietly and without knocking, although it was running at about

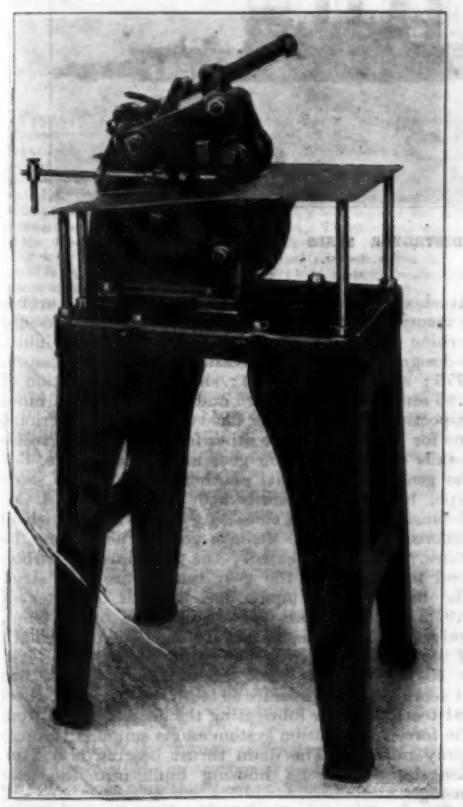


FIG. 16—TANGENT SHEARING MACHINE

280 revolutions per minute. It is thus possible to connect it with a normal high-speed motor with a short belt drive. The pump has a brass ram and a steel guide rod, with a forked excentric rod. The crank, it will be seen, is of the double-throw type. The suction and delivery valves are rubber discs, with brass grid seatings, and are held down by helical springs. The standard which carries the crank shaft bearings acts as an air vessel, while the stand-pipe shown connected with the suction is used to flood the valves and assist in priming the pump.

SHEARING AND PUNCHING MACHINES.

Some novel shearing and punching machines, several of which we illustrate, were exhibited on the stand of the Tangent Tool and Engineering Company, Limited, of Keynsham, Somerset. The two shearing machines shown in Figs. 16 and 17 both have rotary cutters, of which the lower one is driven while the top cutter is free to rotate. The cutters, the edges of which are roughened so that they may grip the plate, are placed with their edges just overlapping. When

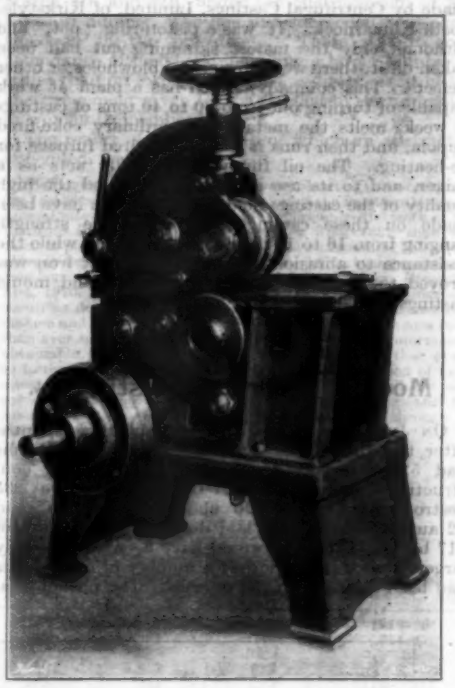
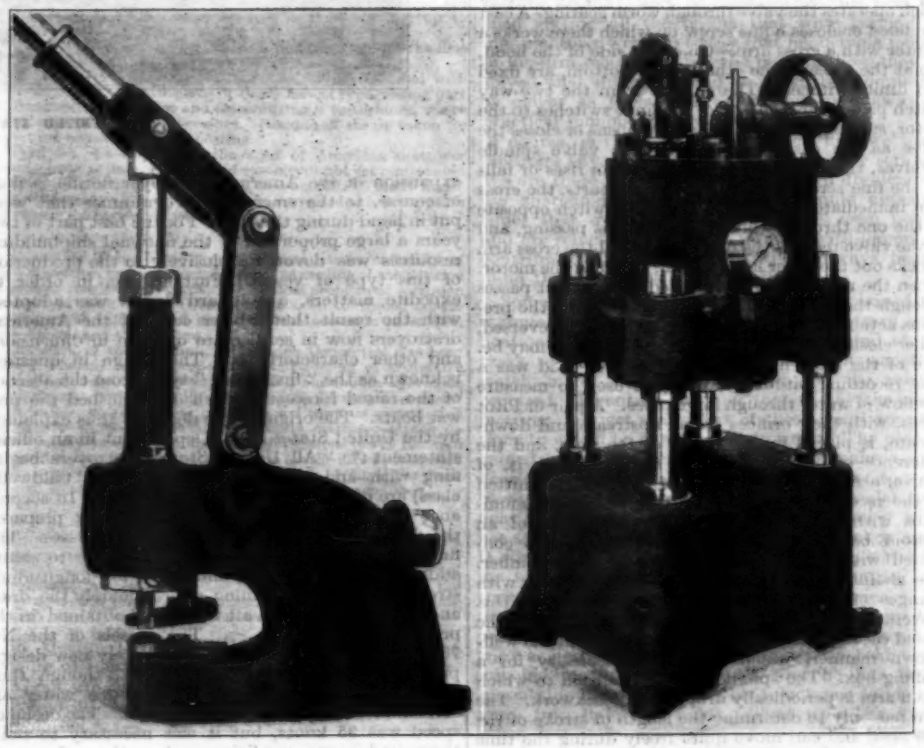


FIG. 17—TANGENT SHEARING MACHINE

a plate is pushed between the cutters the lower one seizes it and drags it forward, while the action of the two cutters shears the plate through quite cleanly. The two separated pieces pass on opposite sides of the frame without being distorted. The lighter machine, which is intended to cut up to ½in. steel plate, is provided with a trip mechanism for stopping the cut at any desired length. There is a finger on a rod projecting from the back of the machine which can be set for the required length. When the plate strikes this finger a catch is released, and the frame carrying the top cutter is drawn clear of the plate by a spring, with the natural consequence that the cut is stopped. The cutter is re-set by pressing on the plunger seen projecting from the front of the machine. In the case of the larger machine, which will cut up to ½in. plate, the forces involved are too great to permit such a method of tripping being used, and a clutch in the drive of the cutter is operated instead. The cutting speed of the light machine is 50ft. per minute, while the larger one works at 15ft. per minute. The same principle of rotary shears is adopted in a number of hand tools for cutting corrugated iron and other light metal, which were also exhibited. The punch shown in Fig. 18 obtains its leverage by hydraulic means, and really needs very little description. A long-stroke plunger of small diameter is used to supply water under pressure to a comparatively large ram, to which the punching tool is attached. The cylinders communicate directly with one another, and cup leathers are used to make the joints tight. The proportions of the plunger and the ram are such that a force of 6 tons can easily be obtained at the punch, and we saw a man of average weight produce a pressure of over 8 tons when hanging on the end of a lever about 3ft. 6in. long. It is obvious that the idea is not necessarily confined to punches, and we noticed several machines embodying the ram principle for shearing, straightening bars, and cropping angles. The machine shown in Fig. 19 might be described as the hydraulic equivalent of the ordinary belt-driven punching or shearing machine. That is to say, it automatically gives a continuously reciprocating motion to the punch so long as the pumps are kept running. A tappet rod attached to the ram actuates the quadrant seen at the top of the machine. This quadrant, in turn, moves a striking rod, which so controls two valves in the pump delivery that the water is sent either to the top or the bottom of the ram. The area of the ram for the upward stroke is smaller than for the downward stroke, so that a quick return is effected. There is a safety valve on the pump delivery to prevent damage to the pumps if anything should go wrong. It is proposed to elaborate the idea of this machine by giving the pump plungers a variable stroke and to adapt it to various classes of work.



FIGS. 18 AND 19—HAND AND AUTOMATIC HYDRAULIC PUNCHES

ELECTRIC AND BLOW-PIPE WELDING.

Both electric and blow-pipe welding plants were well represented at the exhibition on the stands of several different firms. Among the former class there were some equipments by the Premier Electric Welding Company, Limited, of Bank-buildings, St. James-street, London, S.W. 1, the general principles of which have already been described in THE ENGINEER. The exhibit comprised a petrol-driven portable set, which was demonstrated at work arc welding, another set on a trolley for tramway and similar work, besides a quantity of smaller plant and an alternating-current equipment. The Foster Engineering Company, Limited, of Morden Works, Wimbledon, had a handy little spot welder and some welding transformers among the general electrical appliances which it was exhibiting.

The blow-pipe method of welding was demonstrated by the Hyde Welding Company, Limited, of Lower Walsall-street, Wolverhampton, which specialises in the junction of dissimilar metals, such as steel and copper, in an atmosphere of hydrogen, so that the use of special fluxes is avoided; while Hancock and Co. (Engineers), Limited, of Wallington, Surrey, had a plant for welding or cutting, which was at work using town's gas at ordinary pressure, and, of course, oxygen. The Godfrey oxygen jet cutting machine is not really a welding device, and has already been described in our columns, but it

seems appropriate to mention it under this heading. The makers, the Godfrey Engineering Works, of Boundary-road, London, N. 22, had a machine at work at the exhibition, and were executing work which was, if anything, even more clean than that which we saw when last the machine was exhibited. Incidentally, we heard at the stand that a machine is now in course of construction, 50ft. long, for cutting out locomotive frames. It will cut out a frame from 1¼in. steel plate in three hours, and will, it is expected, save the owners a large amount as compared with the usual system of cutting out.

Hydraulic Presses.

The most novel machine on the stand of Hollings and Guest, Limited, Thimble Mill-lane, Birmingham, was a powerful hydraulic press, capable of exerting pressures up to 200 tons, for putting on or taking off the solid rubber tires of road vehicles. The peculiar feature of this machine lies in the form of the head, which has a slot cut in it from the side to the centre, so that the tires can be taken off a pair of wheels without it being necessary to take the wheels off their axle. The axle is slipped into the slot with one wheel standing up above the press, and the other wheel, which is being operated upon, between the table and the head. The head is a massive iron casting, and deep ribs are provided to compensate for the loss of strength caused by the slot. The framework of the press is built up of rolled steel channels. The table is 4ft. in diameter, and the maximum distance apart of the head and table is 2ft. 6in. There were several other presses on the stand, including one for bundling light scrap iron, so arranged that it can be sunk in the floor for convenience in filling the box. A bending press was shown at work, and there were some hand-operated baling presses.

Water Meters.

On the stand of Glenfield and Kennedy, Limited, Kilmarnock, there were numbers of water meters for both small and large flows, besides a variety of waterworks plant, including an electrical level recorder and an example of the Homeyard hydraulic valve, which we recently described. Among the meters there was one of the well-known Kennedy piston type, specially arranged for dealing with hot water, so that it can be used for measuring boiler feed water. This meter is made in a range of sizes from ¼in. up to 8in., and is guaranteed by the makers to have an error of not more than 1 per cent. The rotary type of meter was represented by a number of examples having celluloid revolving vanes, some of which were arranged to prevent the access of water to the dials and thus obviate their being soiled by dirty water. One of the most striking valves on the stand was one fitted with an electric motor for opening and closing it, a bracket being fitted to the cover to carry the motor, which operates the valve through worm gearing. A cast iron hood encloses a fine screw on which there works a pointer with a cross arm. On either side of the hood, one at the top and the other at the bottom, are fixed two limit switches. The current from the two-way switch passes through one of the limit switches to the motor, starting it up, which in turn opens or closes the valve as the case may be. As the valve spindle revolves, the pointer with the cross arm rises or falls on the fine screw. When the motor starts, the cross arm immediately knocks in the limit switch opposite to the one through which the current is passing, and as the valve reaches the end of its travel the cross arm knocks out the other limit switch, stopping the motor. When the main switch is reversed, the current passes through the limit switch, put in gear during the previous action, and the motion of the motor is reversed, either closing or opening the valve as the case may be. One of the most novel exhibits on the stand was a Cole recording pitometer, which is used to measure the flow of water through large pipes. A pair of Pitot tubes, with their orifices facing upstream and downstream, is placed in the centre of the pipe, and the difference of pressure at these orifices, which is, of course, a measure of the rate of flow, is transmitted to the recording instrument. One orifice communicates with a diaphragm chamber like that of an aneroid barometer, while the other orifice is connected with a sealed case containing the chamber. The chamber naturally expands and contracts with changes of pressure at the Pitot orifices, and this movement is transmitted to a spindle outside the sealed case by means of a pair of magnets in the well-known manner, which avoids the necessity for a stuffing-box. The spindle moves a cam on to which a pen arm is periodically dropped by clockwork. The cam has only to determine the length of stroke of the pen arm, and can move quite freely during the time that the pen is held clear by the clockwork. It will thus be seen that there is practically no friction in the mechanism to be overcome by the difference of pressure at the orifices, and the instrument is very sensitive. Every meter is calibrated in place, and the cam plate is so shaped that the chart gives an accurate record of the water flowing. The pitometer rod is so arranged that it can be passed through a full-way plug cock screwed into the water main, and may thus be removed when not required. The arrangement also facilitates the contrivance of a portable meter. Plug cocks can be fixed in the main at any places where it may be desired to take a measurement of the water. The pitometer tube can then be inserted through any one of them and connected with a portable instrument, which is sufficiently light for one man to carry it about.

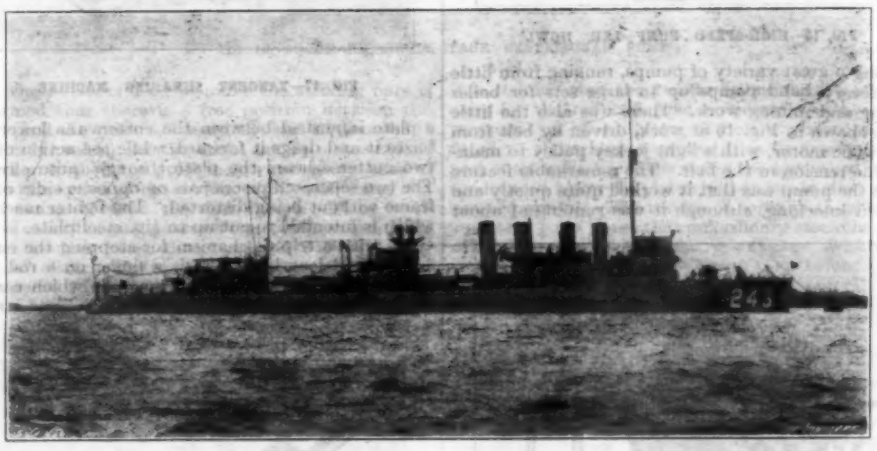
Centrifugal Castings.

An interesting exhibit, also on Messrs. Glenfield and Kennedy's stand, was a sample centrifugal casting made by Centrifugal Castings, Limited, of Kirkstyle-road, Kilmarnock. It was a piston-ring "pot," and although only the merest skimming cut had been taken off it, there were no signs of blowholes or other defects. This company, which has a plant at work capable of turning out from 30 to 40 tons of castings a week, melts the metal in an ordinary coke-fired cupola, and then runs it into an oil-fired furnace for re-heating. The oil furnace practically acts as a mixer, and to its use is largely attributed the high quality of the castings made. Tests which have been made on these castings show a tensile strength ranging from 16 to 19 tons per square inch, while the resistance to abrasion of centrifugally cast iron was proved to be about 1.8 times that of sand mould castings.

Modern American Destroyers.

On July 1st, 1917—that is, about three months after the United States had entered the war—she had 52 destroyers completed and 62 under construction. On July 1st, 1920, there were 235 destroyers completed, 70 under construction, and 12 authorised, but not laid down—a grand total of 317 boats. This total would have been considerably larger but for the fact that a number of older boats had been scrapped in the interval. The phenomenal expansion of the American destroyer flotilla is due, of course, to the emergency programmes that were put in hand during the war. For the best part of two years a large proportion of the national shipbuilding resources was devoted exclusively to the production of this type of vessel. Furthermore, in order to expedite matters, a standard design was adopted, with the result that 90 per cent. of the American destroyers now in service are uniform in dimensions and other characteristics. The design in question is known as the "flush-deck" type, from the absence of the raised forecastle which distinguished the pre-war boats. The origin of the design is thus explained by the United States Navy Department in an official statement:* "All United States destroyers beginning with and subsequent to No. 69 ('Caldwell' class) are of the so-called flush deck type. In accordance with practice, the Navy Department prepared the designs of this and the subsequent classes. The flush deck feature was introduced in order to secure added depth of section amidships for longitudinal strength while maintaining approximately the draft and freeboard fore and aft which had obtained in the preceding classes. . . . The vessels of the No. 75–185 class were built from an entirely new design, prepared by the Navy Department, though their length and general arrangement above water are similar to those of the preceding class. The designed speed was 35 knots, but it was necessary to build them under war conditions, when the refinements essential to the success of this class of vessel were particularly difficult of attainment. Most of the boats were built to a guarantee of shaft horse-power rather than speed, and the type of the machinery installed by the several builders differed materially. In spite of these difficulties, the majority of the vessels have actually realised the designed speed, very few have been over weight, and all have developed the guaranteed horse-power. . . . The flush deck vessels have proved to be very seaworthy under severe conditions of service. The period of roll is appreciably greater than in many other destroyers of similar size and type, and the recovery at the extreme of each swing is easy and natural." Very few of the boats were completed in time to take part in the war, but such as did proved particularly useful for convoy duty and other work which demands a high degree of weatherliness and an extensive cruising endurance. During the past three years considerable numbers of the "flush deckers" have served in European waters, and many of them have visited our ports. A general description of the Sands—which, through the courtesy of the commanding officer, was inspected some months ago by a representative of The Engineer—will apply to the 270 odd vessels of the flush deck type now in service.

The Sands was authorised on October 6th, 1917, and the contract for her construction signed with the New York Shipbuilding Company, of Camden, New Jersey, on December 29th, 1917. The keel was laid on March 22nd, 1919, the launch took place on October 28th, 1919, and the vessel ran her trials in December, 1920. Her principal dimensions are:—Length on designed water line, 310ft.; length overall, 314ft. 4½in.; breadth on load water line, 30ft. 11½in.; mean draught, 9ft. 4in.; normal displacement, 1215 tons; tons per inch immersion, 15.5; full load displacement, 1308 tons; draught aft, 9ft. 9½in. The main engines were designed for 27,000 shaft horse-power and a speed of 35 knots. No trial figures have been published, but it is understood that the power requirements of the contract were fulfilled. The propelling machinery comprises two sets of Westinghouse geared turbines, operating twin screws, and supplied by four White-Forster boilers. The turbines are situated in separate compartments, one forward of the other, the starboard set being placed abaft of the port installation. Each compartment contains a high-pressure and a low-pressure turbine, the pinions of both meshing with one gear, which is attached to the propeller shaft. The astern turbine is incorporated in the after end of the low-pressure turbine casing. The turbine revolutions per minute, as designed, are:—High-pressure, 2988; low-pressure, 1775; speed of shaft, 436; signifying a reduction of 6.85 and 4.07 for the high and low-pressure turbines respectively. The former has two steam connections, one for cruising and the other for full speed. Precise details of the reduction gear are not available, but the gears in the Dent, another vessel of the same type, have been described by Commander S. M. Robinson, U.S.N., as consisting of two double helical pinions meshing into a single gear. The pinions, he states,† are of nickel steel; the gear rims are carbon steel forgings, and the gear centres are cast steel. The high-pressure pinion has a pitch diameter of 9.91in., the low-pressure a diameter of 16.69in., and the gear a diameter of 67.96in. The total length of tooth face is 37½in. The spiral angle of the teeth is 39 deg. 53 min. The high-pressure pinion has 41 teeth, the low-pressure 69 teeth, and the gear wheel 281 teeth. Oil for lubricating the gears is taken from the forced lubrication system and is supplied through spray nozzles. The main thrust bearing is a 21in. Kingsbury with its housing built into the gear casing.



THE UNITED STATES DESTROYER SANDS

The Sands is fitted with four White-Forster boilers designed to burn oil fuel on the mechanical pressure atomisation principle, and having a total heating surface of 27,000 square feet. They are grouped in pairs in water-tight compartments. Each boiler has an independent funnel which rises 20ft. above the main deck. The oil-burning equipment is similar to that of the Dent, which comprises two light service "booster" pumps, four heavy pressure duplex service pumps, and two oil heaters, half of this equipment being situated in each of the two fire-rooms. The "booster" pumps draw oil from the stowage tanks and pass it to the service pumps, whence it is delivered to the burners through the oil heaters. The fuel is supplied at a pressure of about 250 lb. per

* Published in "Fighting Ships," 1921.

† *International Marine Engineering.*

square inch. There is a small hand pump in each fire-room for raising steam. Air for combustion is supplied at a pressure of about 8in. water pressure by six vertical turbine-driven blowers, three in each fire-room. There are two turbo-generating sets, each of 25 kilowatts, 125 volts, of the 8-25-7200/1200 type. The total weight of the machinery in the Sands is 453 tons. At full power the propellers run at about 470 revolutions per minute. The maximum supply of fuel oil is 288 tons, which endows the vessel with a cruising radius of 4960 knots at the economical speed of 15 knots. As all the fuel tanks are below water line, the stowage capacity is the same in war as in peace. It should be added that the general lay-out of the engine-rooms in the Sands is very compact, and the space, though apparently adequate for all purposes, is rather more restricted than in our early "Admiralty V" destroyers, of only slightly greater displacement.

It is obvious that every detail of the "flush deck" design has been carefully thought out, a very necessary precaution in view of the large number of boats that were to be built to the same plans. The officers, who berth forward, have excellent cabin accommodation, and the wardroom is of unusually generous proportions for this type of vessel. All these quarters, as well as the mess decks, are steam heated. As regards the general appearance of the "flush deck" type, it is proposed to make the whole of the 270 boats uniform in this respect. For this reason a special interest attaches to our illustration of the Sands, as she is shown with the rig and disposition of guns and searchlights that will eventually be adopted for the entire class. Her armament consists of four 4in. 50-calibre quick-firing guns, one 3in. 23-calibre anti-aircraft gun, and twelve 21in. torpedo tubes on triple deck mountings. One 4in. gun, fitted with a spray shield, is on the forecastle; one is placed at each side amidships on the deck-house, and the fourth is mounted on the after deck-house, the anti-aircraft gun being on the quarterdeck. In the earlier representatives of the type the after 4in. gun was on the quarterdeck and the anti-aircraft gun on the forecastle abaft the 4in. bow-chaser. The drawback to the present arrangement is that the 'midship 4in. would be difficult to fight effectively when the ship was rolling, owing to the large arc through which they would move. It is difficult to resist the conclusion that the military value of the type would have been increased by adopting a centre-line superposed arrangement for the gun armament, as first introduced in the British "Admiralty V" class. The torpedo tubes are mounted abaft the funnels *en échelon*, the port groups being forward of the starboard groups, though only six tubes bear on either beam. They appear to be of rather heavier construction than the tubes of earlier American destroyers. The spoon of each tube hinges back, enabling the practice or war head to be changed without removing the torpedo from the tube. Two 24in. searchlights are mounted *en échelon* on a raised platform between the torpedo tubes. A system of director control for the guns is to be installed in all the "flush-deckers." The appended table shows the development of the American surface torpedo vessel from the Cushing, of 1888, to the modern "flush-decker," and incidentally brings out the large cruising radii of these vessels.

Development of American Torpedo Craft.

	No. 1. Torpedo boat Cushing.	No. 2. Destroyer Decatur.	No. 3. Destroyer Smith.	No. 4. Destroyer Paulding.	No. 5. Destroyer Wadsworth.	No. 6. Destroyers, "Flush-deck" type.
Year of launch	1890	1900	1909	1910	1915	1918–20
Length overall, feet	138	245	294	294	310	314.4
Breadth extreme, feet	15	23	26.4	26.4	29.6	31
Draught, feet	4½	6½	8	8.3	9.4	9
Displacement, tons	91.3	420	700	742	1050	1160/1215
Horse-power	1720 (indicated)	8000 (indicated)	9950 (shaft)	17,393 (shaft)	17,000 (shaft)	28,190 (shaft)
Revolutions per minute	370	330	724	903	460	470
Number of screws	2	2	3	3	2	2
Fuel capacity, tons	33 (coal)	186 (coal)	304 (coal)	241 (oil)	326 (oil)	290 (oil)
Cruising endurance, knots	990 (at 10 knots)	2160 (at 12 knots)	2800 (at 16 knots)	3000 (at 16 knots)	5640 (at 16 knots)	4960 (at 15 knots)
Boilers	2 Thornycroft	4 Thornycroft	4 Mosher	4 Normand	4 Normand	4 White-Forster
Total heating surface, square feet	4750	17,770	18,003	19,321	21,500	27,000
Total grate surface, square feet	76.6	237	368.5	—	—	—
Maximum speed on trial, knots	22.5	28.10	28.35	32.8	30.67	36.88
Armament	2 3-pr. Q.F., 3 18in. torpedo tubes	2 3in. Q.F., 4 6-pr. Q.F., 2 18in. torpedo tubes	5 3in. Q.F., 6 18in. torpedo tubes	5 3in. Q.F., 6 18in. torpedo tubes	4 4in. Q.F., 8 21in. torpedo tubes	4 4in. Q.F., 1 3in. A.A., 12 21in. torpedo tubes

NOTES TO ABOVE TABLE.

Type No. 1.—The Cushing had two five-cylinder quadruple-expansion engines, cylinder diameters 11¼in., 16in., 22½in., 22½in., 22½in., stroke 15in. The supports were 1¼in. steel rods, braced diagonally, and forming cap bolts of the main bearings, the latter being secured to a bed-plate of ½in. wrought iron. This bed-plate was secured in a fore-and-aft direction to keelsons, with additional supports under the main bearings of the high-pressure and after low-pressure cylinders. There was no support to the other main bearings; but, thanks to the care with which they were balanced, the engines worked without vibration. A novel feature of the Thornycroft boilers was that the longitudinal seams in the drums were welded instead of riveted.

Type No. 2.—These were the last United States destroyers equipped with reciprocating engines. The high-pressure cylinders were 23in. in diameter.

Type No. 3.—The first United States turbine destroyers. A very successful type. One or two of the class exceeded the designed speed by nearly 4 knots, the Reid working up to 31.82 knots.

Type No. 4.—In this type oil fuel was introduced for the first time.

Type No. 5.—The first United States destroyers fitted with reduction gears. Gearing was of single helical type, taking part of propeller thrust direct and transmitting it to turbines, where it is balanced by steam pressure. Residue of thrust taken by a pivoted segmental thrust bearing.

Type No. 6.—Represents the apex of American destroyer development to date. Flotilla leaders—a type not yet represented in the United States Navy—of 1900 tons and 60,000 shaft horse-power are said to be projected, but no vessels of this description have been authorised as yet.

THE possibility of constructing a harbour at False Point, Cuttack, India, is to be investigated by an English firm of consulting engineers.

Institute of Metals.

No. I.

THE annual meeting of the Institute of Metals was held at the Institution of Mechanical Engineers on March 8th and 9th, under the chairmanship of Mr. Leonard Sumner, who has just succeeded Sir George Goodwin in the presidency. There was a good attendance of members, including a larger number of ladies than on former occasions, a direct result of the encouragement given by the Council to the admission of women to membership.

The report of the Council, of which an abstract is appended, was adopted.

The Council are pleased to be able to submit to the members of the Institute of Metals, on the occasion of the fourteenth annual general meeting, a more favourable report upon the work of the Institute for the year ended December 31st, 1921, than was thought possible earlier in the year. Notwithstanding the period of trade depression through which the world has been passing, the membership has actually increased—from 1298 on December 31st, 1920, to 1410 on December 31st, 1921. Such an increase, occurring during a year of unparalleled difficulty, indicates that makers and users of non-ferrous metals and alloys are now more than ever ready to take advantage of the scientific information obtainable through association with the Institute that exists to foster their interests. It is largely by the adoption of more scientific methods that British manufacturers will be able successfully to meet foreign competition, and it is here that the Institute is able and willing to render assistance through its meetings and publications.

WORK OF CORROSION RESEARCH COMMITTEE.

A pamphlet entitled "Notes on the Corrosion and Protection of Condenser Tubes" has been published on the authority of the Committee, and is intended to give an outline of the position at present reached as regards the practical problem of corrosion by sea and fresh water. Research has been continued on the factors which initiate and accelerate the corrosion of copper, zinc, nickel, and their alloys.

The work of the Aluminium Corrosion Committee has been largely devoted to the preparation and testing of protective coatings of molybdenum compounds and aluminium hydroxide on aluminium and certain light alloys; this investigation is still in progress. Work has also been directed towards ascertaining the factors which initiate and accelerate corrosive attack on commercially pure aluminium. Certain sections of the research rendered it desirable to obtain a method for the direct estimation of aluminium, and a considerable amount of time has been devoted to the testing and comparing of possible methods.

BEILBY PRIZE RESEARCH.

The work on the solidification of metals has been interrupted by many causes, especially by the large influx of students and by the departure of research workers to take up other duties. The mass of material which has been accumulated during the last two years is now being arranged, and experiments are being made to clear up the points which were left in doubt.

Sir George Goodwin, who had presided at the opening of the meeting, then inducted his successor, Mr. Leonard Sumner, into the chair, and the latter delivered his inaugural address, an abstract of which is given below:—

PRESIDENTIAL ADDRESS, by LEONARD SUMNER.

I AM neither engineer nor metallurgist. Whatever I may have known of either engineering or metallurgy is now hopelessly out of date, and that which I once knew I have now forgotten. I am interested in the manufacturing branch of our industry, but, through the force of circumstances, my own preoccupation has gravitated to the commercial side of the industry. It would therefore be presumption on my part if I were to attempt to give an address based on the scientific side of the activities of the Institute.

My remarks will consequently be confined to the commercial aspects of the Institute. In so doing, I do not think I need offer any apologies for alluding to this humdrum and—perhaps what some of you may think—this rather sordid side of the industry. As is perfectly well known, the prosperity of the country depends entirely on the prosperity of its industries, trades and commerce. So it is with an Institute such as this. The prosperity, and therefore the utility and activity of the Institute is dependent upon the state of trade of the country, and more particularly upon the prosperity of the non-ferrous industry. It might be argued that in reality the prosperity of the industry depends upon maintaining the activities of the Institute, and that the efficient prosecution of our industry depends very largely upon the information to be gleaned from the papers read and discussions that take place at our meetings. I do not think that this is quite the correct view. It must be remembered that the industry "flourished"—perhaps that is hardly the correct word; shall I say "made a living"?—before the Institute was founded. As a manufacturer, I am most willing to bear testimony to the very great benefit that the industry has derived from the Institute, and I think that the fortunes of the industry and the fortunes of the Institute are closely interlocked and entwined. Most of us are members of this Institute, not only because we are interested in and fascinated by the study of the behaviour of the non-ferrous metals and their various alloys, but because we are engaged either directly or indirectly in their production or in their use, and our living depends upon the industry. It is therefore of vital necessity to the great majority of us that the proved usefulness of the Institute shall be not only maintained, but if possible increased.

I think there is a feeling, which at first sight would seem justifiable, that manufacturers do not contribute their quantum to this Institute. In a degree I am rather inclined to agree with those who hold that view. It has been said that manufacturers do not contribute papers nor take part in discussions as they should—in other words, that they do not take their share in imparting knowledge. May I say that the manufacturer is in a very difficult position. As an illustration, let me recall to your memories an incident that occurred at our last autumn meeting. A practical paper was read, giving the difficulties which the author had had in obtaining a sound article. The President called upon some manufacturers to reply. Not one spoke, and the President administered a somewhat severe castigation to manufacturers, which, judging by the general applause, met with general approval. Later, I spoke with a manufacturer and asked him why he had not contributed to the discussion. His reply was that the particular difficulty which had been alluded to by the contributor of the paper had been solved by his firm, and that his firm had no difficulty in turning out a perfectly satisfactory article; and, in consequence, his firm were then getting all the orders that were going. The manufacturer went on to say that he, being a member of his firm, could not tell the meeting how they had solved that difficulty, and so make his competitors as clever as themselves, and thus give away the practical monopoly they were then enjoying. That, of course, is the commercial aspect, and we manufacturers have to consider that aspect very seriously. We are there primarily to try and earn dividends for our shareholders. If therefore it would appear at times that we manufacturers do not seem helpful, and are reluctant in coming forward with papers and contributions, I would ask you to always bear in mind the difficulties of our position.

Some years ago Sir Gerard Muntz complained that manufacturers had to work to some arbitrary specifications, and that we had some weird and strange tasks to perform, whereby the user got something which might be quite unsuited for the purpose required. I venture to think that to-day the manufacturer does get many less of these weird specifications to which he is requested to work. The user has gained knowledge, and if he does now make a specification to which he asks the manufacturer to work, there is usually some reason for that particular specification; it may be that he has had an alloy which has satisfied his needs, and he wants that alloy again. It does not follow that the alloy he has used is the best for his purpose, but he is afraid to venture into trying anything new when his experience has taught him that the alloy he specifies has, up to a point, met his requirements. Possibly he may have tried something else which he had been told would suit his purpose equally well, and he has had a lamentable failure. Hence, his reluctance to venture again into unknown fields. That user has knowledge, but it is not sufficient to enable him with confidence to vary his specification. Then there are other users who may have little or no knowledge of non-ferrous metallurgy. These users generally make no specification, but leave it to the manufacturer to supply what he thinks most suitable. If the material supplied is unsatisfactory, then the onus falls on the maker. Whatever the attitude taken by the user, the position is unsatisfactory for both user and manufacturer. What would be ideal would be that the user should consult with the manufacturer; the user should explain his views to the maker; the maker should give his views; and that both parties should be so well acquainted with the properties of various alloys that between them a suitable alloy would be produced to meet the user's

needs. That is the ideal. We have not arrived at such a state yet, but I do believe that with the closer co-operation between user and maker, and with the greater metallurgical knowledge of both, then we are approaching that ideal. In bringing this state about, I am convinced that our Institute will take a leading part. The Institute can teach this, and, as Sir Gerard said, it would come with more weight from an Institute embracing so many different classes of thought than from anywhere else.

Generally speaking, however, that branch of industry with which I am connected has usually to work to specifications which have been drawn up by responsible bodies, such as the Admiralty, War Office, or the British Engineering Standards Association. These specifications have been put into force after consultation with the manufacturer. The clauses in these specifications have been so worded that, provided the manufacturer will produce an article which will conform to the required conditions, the manufacturer has retained a certain amount of liberty and discretion as to the raw materials he may employ in the production of the article; and I understand that the other branches of the non-ferrous industries have had similar latitude allowed them in their choice of their raw materials. I am firmly of opinion that this attitude which has been adopted by those responsible for making the specifications has been a very sound and an eminently reasonable one. It has enabled the manufacturer to use his discretion and knowledge as to the kind of raw material that he should use. The manufacturer has not been unduly cribbed, cabined and confined in his selection of his raw material; and, if he does make a mistake in his judgment, then he suffers the penalty of having his manufactured goods rejected. I am convinced that it is all to the good of the industry that the manufacturer should have this latitude instead of being too strictly bound by a specification as to what he may or may not use. The policy of allowing a certain amount of freedom to the manufacturer has, I maintain, been a good one, and I trust that it will be continued in the future as far as possible.

As I have said, the position between user and maker is at present unsatisfactory, and I would ask, "Are makers altogether free from blame for this unsatisfactory position?" I am afraid they are not. Makers have in the past—and are doing so still to-day, although perhaps in a lesser degree—pushed their wares under a fancy name or names. A manufacturer in a commercial world-such as ours must try and get orders, and, if a name of some sort or another will enable him to get those orders, then it is inevitable that the manufacturer will push those goods to which he has given the fancy name. When trade is slack or bad, the tendency is still greater for the manufacturer to try and sell something to which he has given the fancy name. The alloy or metal may be, and often is, quite an ordinary alloy, but it will be dubbed, say, "Smith's Bronze" or "Jones's Metal." The firm may be convinced that they have got something that is really good, but it is quite possible their tests have not been carried far enough. The traveller goes out and preaches the virtues and the merits of, say, "Jones's Metal," and he prates loudly of what this metal will do, and he is cautious enough, if he is properly posted, not to say what it will not do. The traveller is more often than not glib of tongue; he knows a little metallurgy, but very little; he gives results of tests of the metal which very likely are not applicable to the use to which the user wants to put the metal. The user is impressed and thinks the metal worth trying, and gives an order. The user perhaps knows nothing or very little about non-ferrous metals and their uses and applications: that is the pity of it. This metal may turn out in some cases perfectly satisfactory, or it may not. The whole thing is a lottery. This procedure may be business, but it is the wrong type of business. This type of business may last for some time yet, and probably will, but in these days of scientific work and research there is no doubt that before many years are past no manufacturer will dare to offer any material unless he is prepared to vouch for its properties under the varying conditions for which it may be required. That time is bound to come.

I have mentioned ideals. Ideals sometimes become realisations; and I am bold enough to assert that the time is coming when no "Jones's Metal" or "Smith's Bronze" will be accepted by the user unless the manufacturer is prepared to lay his cards on the table and say at once what his alloy consists of. The alloy may be called any name one likes, but its constituents should be stated, and the maker should be prepared to stand by or fall with the metal he puts on the market. I have noticed that in recent times the tool steel makers, where they are still advertising their goods under their different trade names, are giving a complete analysis of the different grades of steel which they offer for varying purposes. This is an example which might with advantage be copied by the manufacturers of the non-ferrous metals, and, in the case of the more enlightened firms in the non-ferrous trade, is being put into practice. This position of affairs emphasises the paramount necessity, which Sir George Goodwin has laid stress upon, that engineers in their training should receive instruction in metallurgy, and also that metallurgists should also receive some training in engineering, so as the better to appreciate the engineer's needs and the difficulties with which he is confronted. We know that naval engineers are now receiving instruction in metallurgy, but that is not enough. Are all our universities and colleges which give degrees in engineering insisting that one of the subjects which the student must qualify in, if he is to get his degree, is metallurgy? I think not. One or two, notably Birmingham University, do so insist on some metallurgical knowledge, but there are others which give no metallurgical training to a man who is taking an engineering course. I should like to emphasise with all the power at my command the immediate necessity of engineers receiving this metallurgical training, and of metallurgists receiving some engineering training. I think it is vital if the engineering and metallurgical interests of this country are to progress and maintain their position in the future. The two industries must to a very large extent march forward together, and one cannot wait whilst the other lags behind.

I will now say a few words about the training of metallurgical students. What do we who are in charge of commercial undertakings in the non-ferrous industry find? It is one of the greatest difficulties we have to find a man suitable for these positions. A fellow-competitor was telling me only a short time ago that he could get trained metallurgists, chemists, engineers in plenty, but that he could not find the right man for the managership. Why should this be so? The man in charge of a mill who is keen on his product and his output, and can get the very best out of the workers under him, should be simply invaluable, but is, in my experience, failing in appreciation of the fact that organisation, detail and discipline are essential to the successful running of a commercial undertaking. For instance, the bringing together of figures for the cost clerk may be distasteful and irksome to him, and he probably resents the cost clerk perhaps questioning some of the figures that he has sent up to the office. He would seem to fail altogether to appreciate the necessity for accuracy; and accurate costing is of the greatest importance in a factory. He fails perhaps to work with other departmental heads. He may be running his mill on A's order, and word comes to stop production on this order and turn on to B's order. This upsets his arrangement, and he resents it. He does as he is requested, but unwillingly and grudgingly. Why should this man be lacking in these essentials for works management?

Is it a fault of his training? I do not express an opinion, but I would like our professors and teachers to ponder over the fact and ask themselves why it is that the students they have trained so carefully and with so much pains do not rise, generally speaking, to take those higher positions on the non-ferrous manufactures to which it would seem their training would eminently fit them. I am not sure that in the training in this country we do not specialise a little too much, and that the training should not be broader and more varied. Sometimes, too, I am inclined to think that our teachers are prone to be too much interested in the brilliant student, to the possible neglect of the student who is not so clever. They seem to overlook the fact that industry requires many sound and able men and but a few brilliant men.

The meeting then proceeded with the reading and discussion of papers, the remainder of the opening session being occupied with the presentation by Dr. G. D. Bengough of "Notes on the Corrosion and Protection of Condenser Tubes" and the discussion of the work described and theories advanced.

In an introduction to the account given of his work by Dr. Bengough, it was pointed out by Dr. Carpenter that the paper represented the considered opinion of the author, who had been investigating the problem of the corrosion of condenser tubes in manifold aspects for a period of ten years. He had been able to include in it very definite conclusions, based upon experience of the practical working of condensers under a great variety of conditions over the same period. The author's statement had been revised by certain members of the Committee, notably Sir Gerard Muntz, Mr. W. A. Dexter, and Engineer-Rear-Admiral Dixon, with the object of securing attention to the points of view of the manufacturer, the maker of the condenser and the user. The statement to which Dr. Bengough's name was attached was therefore the most authoritative expression of opinion on methods of protecting condenser tubes from corrosion that it was possible to prepare at the present time.

Dr. Bengough gave a brief summary of his notes. He pointed out that the subject was complicated for the reason that it involved chemical and electro-chemical reactions which varied with different types of water, temperature and time, engineering conditions which were difficult to elucidate, and complex metallurgical factors. It frequently happened that a case of corrosion could not be assigned to a single cause, but was the net result of a number of factors working together. Dr. Bengough classified the causes of tube failure under the two heads of (1) causes which are due to the tubes, (2) causes arising from conditions external to the tubes. The former included (*a*) laminations and spills; (*b*) faulty composition; (*c*) unsuitable crystalline structure; (*d*) mechanical weakness. External conditions:—(*e*) Local accumulation of corrosion products; (*f*) settling of foreign substances on the tubes, sometimes giving rise to (*e*); (*g*) subsidiary supplies of steam entering condenser apart from main, giving high local temperature and sometimes external erosion; (*h*) inlet deterioration on upper internal surface of tube; (*j*) electrical leaks and thermo-electric action; (*k*) water speed, especially with dirty inlet water, as in certain harbours and docks; (*l*) entrance into certain waterways, especially when tubes are new—*e.g.*, ship canal and certain tropical rivers, certain docks, the Tyne at certain periods of the year, the upper reaches of the Clyde; (*m*) air sucking due to rolling in bad weather, air leaks in pump line, &c.; (*n*) unsuitable design of water end; (*o*) ferrule troubles; (*p*) too high a temperature; (*q*) the presence on new tubes of certain iron compounds; (*r*) "short circuiting" of contaminated cooling water; and (*s*) seasonal or other variations in water composition. Of failures due to external conditions, a fairly common form of deterioration of tubes was one which occurred at the inlet end, a type of attack due to the local formation of a foam clot. The effect of water speed was one of the most complicated phenomena in corrosion problems, and it was exceedingly difficult to separate its specific effect from other causes. It was the speed near the walls which was most important, and it had been noted that increased speed was associated with increased corrosion. With regard to foam formation, the principal factor in producing foaming in sea water was probably sodium chloride. Oil formed fairly consistent foams with air, and that was one of the reasons why new tubes were liable to attack in builders' yards and in certain rivers and ship canals. Tubes were most sensitive to adverse conditions when first placed in the condenser. Methods of lessening corrosion fell under various heads, as the cause was unlikely to be the same in any two condensers, and a remedy useful in one case might be quite useless in another. Electrolytic protection was that most widely used, and in this connection the use of steel protector blocks deserved more consideration. As an improvement on steel blocks, alloy blocks consisting largely of aluminium had been employed with successful results. In practice, it was essential to give special attention to the proper insulation of the anode from the rest of the condenser. In his opinion, there was now sufficient evidence in favour of the use of a low annealing temperature, *i.e.*, three hours at 350 deg. Cent., in an oxidising atmosphere, to justify its extended use in practice for 70:30 brass, 70:29:1 tubes, and perhaps arsenical copper. As it had been shown that carbonate scale on tubes was of great protective value, it seemed an obvious way of preventing corrosion to prepare artificially such scale on the tubes before they were put into use. Experiments on these lines had, however, met with only partial success. A process that seemed more immediately practicable was that of lead-lining the tubes. Such tubes had been used in the German fleet during the war with apparently good results. With regard to the use of alloys other than 70:30 or Admiralty alloy, the use of nickel appeared to be sound practice in all cases in which chloride waters were encountered. Good experience had been gained in the American Navy with a 20 per cent. nickel alloy with copper, and under estuarine conditions these hard-drawn nickel copper tubes probably had a future. They were now being made in Great Britain, and were worth a trial.

The discussion and Dr. Bengough's reply will be dealt with in a further report of the proceedings.

The annual dinner of the Institute was held, with the President in the chair, at the Trocadero Restaurant on Wednesday evening. A distinguished company was brought together, and the function proved a great success, the only drawback being the late hour at which the principal toast was given. The toasts were "Kindred Societies," proposed by Professor Carpenter and acknowledged by Mr. W. B. Worthington, President of the Institution of Civil Engineers, and by Dr. Hele-Shaw, President of the Institution of Mechanical Engineers; "The Institute of Metals" was proposed by Sir Joseph Petavel and responded to by the President.

The terms for the amalgamation of the Hull and Barnsley with the North-Eastern, have now been agreed to by the respective boards of directors. They remain to be confirmed by the proprietors and provisionally approved by the Railway Amalgamation Tribunal.

According to the Board of Trade returns, the value of the railway material exported during the month of January last was as follows, the corresponding figures for 1921 and 1920 being added in parenthesis:—locomotives, £863,081 (£547,428, £326,147); rails, £415,585 (£454,887, £106,953); carriages, £106,592 (£106,443, £156,372); wagons, £529,909 (£494,270, £540,267); tires and axles, £67,093 (£156,615, £122,333); wheels and axles, £153,366 (£249,114, £122,333); chairs and metal sleepers, £211,876 (£202,903, £159,44); miscellaneous permanent way, £173,102 (£225,647, £185,702); total permanent way, £1,046,063 (£1,378,393, £600,930). The weight of the chairs and metal sleepers exported was 13,527 tons (9,456 tons, 778 tons), and of the rails 35,928 tons (17,953 tons, 6707 tons). Locomotives to the value of £230,750 went to India, of £82,530 to the Argentine, and of £433,540 to European countries. Rails to the value of £231,706 went to India, of £81,484 to the Argentine, and of £21,877 to Ceylon.

A Seven-Day Journal.

Deadlock in Engineering Dispute.

THE outlook in the dispute on the overtime and other questions in the engineering industries is admittedly gloomy. A five-hours conference on Wednesday, brought about as the result of the intervention of the Minister of Labour, proved abortive, and the time before the lock-out notices takes effect is now perilously short. In a statement issued by the union representatives the right of employers to exercise managerial functions was conceded, but was coupled with the provision that in the exercise of these functions the parties shall have regard to the Provisions for Avoiding Disputes of April 17th, 1914, which are amplified by the Shop Stewards and Works Committee Agreement of May 20th, 1919, and to the terms of other national and local agreements between the parties. This means that the men propose to retain all the concessions granted for special reasons during the war period. It has indeed been stated by union representatives that they are determined that any restrictions which they were able to impose in engineering establishments as a result of abnormal conditions during and since the war in relation to managerial acts on the part of the firm shall be maintained. In rejecting the union proposals, employers stated that such proposals were diametrically opposed to the agreement of November last. It is admitted that the breakdown of the negotiations has complicated the situation in the shipbuilding industry, where a stoppage is threatened on the employers' proposal for the withdrawal of the war bonus.

Underground Railway Improvements.

PARLIAMENTARY gossip suggests that a modified scheme for the extension and improvement of the Underground Railways, estimated to cost £5,000,000, instead of the £8,000,000 of the original scheme, has been submitted to and approved by the Government, which would be asked to guarantee interest on new capital. It will be recalled that the original plans provided for the widening of the City and South London Railway and a connection between that railway and the London Electric Railway at Camden Town; the extension northwards from Golders Green to Edgware of the Hampstead and Highgate Railway; and the connection of the Central London Railway and the London and South-Western Railway at Shepherd's Bush. One of these schemes, probably the extension from Golders Green to Edgware, has perhaps been omitted. The most urgent work is the enlargement of the South London tunnels and the linking up of that system with the Hampstead Railway.

Sale of Imperial Airships.

GENERAL regret has been caused by the announcement that in spite of the efforts made to utilise the existing British airships for experimental Empire services, or alternatively to employ the airships for test work and the accumulation of data on airship design and construction, the Air Ministry has decided to dispose of the existing fleet and material, together with certain airship stations. It is not believed that the disaster to the Roma has influenced this decision, which is based mainly on a desire for economy, and the inability of Dominion Governments to co-operate in the proposed scheme for airship services. The airships which are to be offered for sale are the R 80, R 33, R 36, and the ex-German L 77, which are completed, and the partially built R 37. There is a considerable quantity of airship material, and the stations which will be included in the deal are those at Pulham and at Cardington, near Bedford. It is difficult to imagine where the Disposals Board will find purchasers in view of the failure of the home Government to obtain the support of Dominion Governments for restricted airship services, and it is probable that it will be necessary to look abroad for buyers.

New Telephone Exchange for London.

THE new Bishopsgate exchange, which was opened on Saturday last in the City, is the twelfth which has been added to the London system within the last two years. It is intended to serve an area including Bishopsgate, Whitechapel, Bethnal Green, and Haggerston. Nearly 1000 subscribers in the new Bishopsgate exchange area whose lines had been accommodated at other exchanges have been connected with the new equipment, and further additions will be made from time to time. The effect of the transfers will be to accelerate the work of joining up subscribers to the neighbouring exchanges, and to provide for development within the Bishopsgate area. A large amount of intricate work on the external cables has been involved in the diversion of subscribers' circuits to the new exchange, and much remains to be done before it will be possible to complete this work. It is proposed at a later date to erect a special building for the Bishopsgate exchange, which will be one of the largest in London, but owing to the pressing needs of the district for telephone facilities the new equipment which is now in use is temporarily located in the premises partly occupied by the Clerkenwell exchange.

Goods Air Express Services.

WITH the completion of the lighting arrangements for night flying on the London-Paris route, it is intended to put in operation next month regular night services in each direction. A number of machines are now being equipped with the necessary instruments and lighting arrangements for these flights, which, it is hoped, will be carried out under practically all-weather conditions. The main object of this experiment is to enable parcels traffic consigned from the provinces to London and Paris to be delivered in Paris and London on the following morning, and to other destinations at an hour depending on the distance from the air termini. Parcels will arrive in London and Paris by rail from provincial centres, will be taken by road motor to the air stations, carried by the night air services, and delivered either direct by road motor or to railway companies for transport to provincial towns. The public has hitherto made only the smallest use of air services for the carriage of goods, but it is hoped that the facilities now provided will stimulate traffic to a considerable extent.

Sir George Carter's Successor.

IT has been assumed in shipbuilding circles that it would not be necessary to go outside the ranks of the company's officials to find a worthy successor to Sir George Carter as managing director of Cammell Lairds. Mr. R. S. Johnson, who has just been appointed to this responsible position, has been engaged at Birkenhead for the past two years, and coming, as he did, with excellent experience, gained at Belfast with both Harland and Wolff and Workman, Clark, he soon established a reputation with his new firm. He has made himself very popular on Merseyside, and it is felt that the management of the Birkenhead establishment is safe in his hands.

Channel Islands Air Service.

IF a subsidy can be secured it seems probable that an air service, mainly designed for the carriage of fruit and vegetables between the Channel Islands and the Thames, may be put in operation at an early date. There would be an appreciable saving of time in the delivery of consignments to the London market, and those behind the scheme are not alone in believing that it has considerable commercial possibilities. It is true that the Thames has not yet been officially proclaimed an air port, an action which awaits another series of experimental flights, some of which will be between the Islands and the Thames.

Lloyd's Register and Italian Shipbuilding.

THOSE who have followed the trend of developments in connection with Lloyd's Register of Shipping are aware that its interests in foreign countries have increased to a considerable extent during a recent period. It is now announced that an agreement has been made between the Register and the Italian Registry of Shipping which will have the effect of enabling Italian shipowners to secure the reputation attaching to classification of their vessels with Lloyd's Register in conjunction with a national classification. It is understood that the agreement provides that the standards of design and workmanship upon which classification with the premier society of the world is based will not in any sense be lowered by the arrangement now made with Italian interests.

Electric Supply Scheme.

THE case for large generating stations was stated by Lord Haldane during the debate on the second reading of the Electricity Supply Bill in the House of Lords, which was carried by a small majority. Lord Haldane pointed out that small generating stations had been shown to be wasteful of fuel, and should be closed down in a great majority of instances. Under the provisions of the Bill he claimed that the generation of electricity would take place on a large scale near the collieries, and that local authorities and the groups which had been organised for the purpose would be in a position to supply current for power and other requirements at a low rate. He suggested that there was a strong case for the abolition of the old system under which 600 generating authorities were working under conditions which lagged behind the modern standpoint. He reminded the House of Lords that in the United States and on the Continent current is being supplied at much lower rates than in this country, a result which he claims is largely due to the system of generating current in super-stations.

Safeguarding of Industries.

ALTHOUGH a number of complaints have been received, and some rejected or withdrawn, no orders have yet been made under the Safeguarding of Industries Act. No fewer than a hundred trades or branches of trades have been in communication with the Government Department concerned, but Mr. Baldwin has intimated in the House of Commons that the majority of these communications have not yet progressed beyond the stage of inquiry with a view of formulating complaints. The consideration of the applications which have already been made will, assurance is given, be completed as rapidly as possible, but delay has arisen from the fact that in a majority of cases the particulars supplied are insufficient to enable the Board of Trade to take action.

Largest Motor Lifeboat.

PLANS have been prepared for a somewhat new type of motor lifeboat which, it is said, will be larger than any yet built. The boat, which is to be stationed at New Brighton, on the Mersey, will be 60ft. long, with 15ft. beam, a normal draught of 4ft. 6in., and a displacement of 60 tons. She will be a twin-screw boat driven by two 75 horse-power motors of the ordinary lifeboat type. The designed speed is from 9 to 10 knots, and the radius of operation about 100 miles. A feature of the design is that in addition to a line-throwing gun a searchlight and life-saving net will be included in the equipment. Two passenger cabins, one fore and one aft, are to be built and will raise the total passenger-carrying capacity to over 150. Appliances will be installed in one of the cabins for rendering not only first aid but warmth and food, for which purpose a stove is to be provided.

Oil in Great Britain.

THE search for home oil fuel resources is not meeting with success. It was stated by the Secretary for Mines, in reply to a question in Parliament, that the only producing oil well at the present time is that at Hardstoft, in Derbyshire, from which the production for the six months ended December 31st last was no more than 78 tons. The evidence so far obtained has not been sufficiently conclusive to enable the Minister to express an opinion as to the commercial possibilities of oil boring in Great Britain. It is, however, fairly clear that the hopes entertained at an earlier date that a successful industry might be established have been practically abandoned, and it is definitely announced that the Government has no intention of introducing legislation to give the Crown any further rights or powers in respect of petroleum than it already possesses. An intimation has also been given that in exercising its powers under the Petroleum Production Act the Government will not interfere with the rights of private individuals further than may be necessary to prevent indiscriminate boring operations.

Evolving the Helicopter.

THE partial success which has been achieved in the design of a helicopter has led to the announcement that the Air Ministry has under consideration the offer of a prize of £50,000 for a helicopter which complies with certain tests. This confirms a statement made at the beginning of January that the sanction of the Treasury was being sought for the offer of this prize. The conditions under which entries are to be received will be announced at a later date, but with regard to the conditions which would have to be fulfilled by competing machines, it is understood that the machine will have to be able to rise 2000ft. by its own power, carrying an airman and fuel for one hour's flight; to remain stationary for half an hour in a 20-mile wind; to fly horizontally at a speed of 60 miles an hour; and to descend without horizontal motion with the engine cut off in a wind blowing at 20 miles an hour. As a result of this earlier announcement applications have already been received from intending competitors. These are altogether premature, and have been laid aside until an official invitation, which may be extended to the whole world, has been issued.

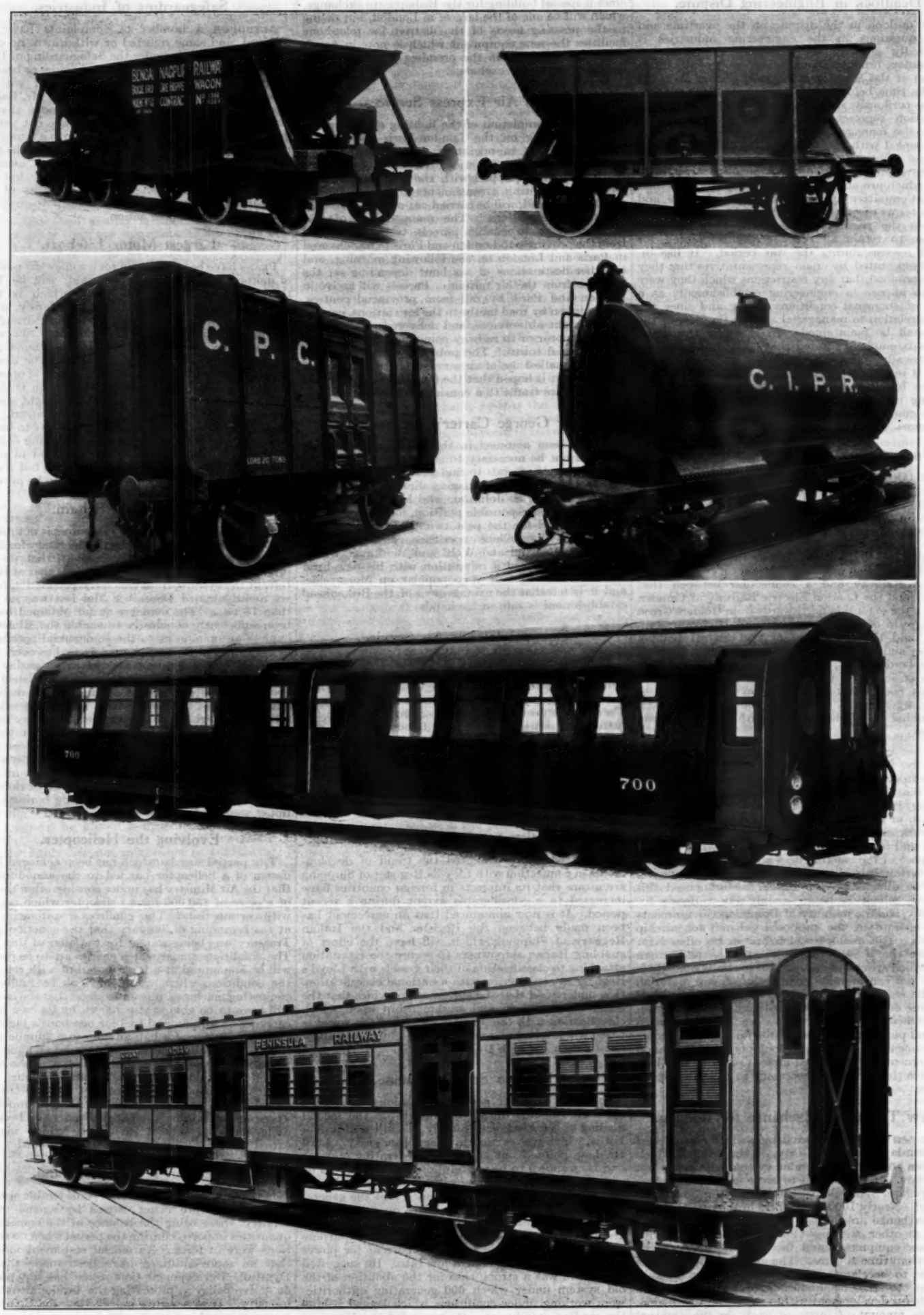
German Dyes in England.

IT is common knowledge that considerable stocks of German dyes are being carried by agents in this country, these being the balance of the considerable quantities imported during the period when no restrictions were in force. An official statement indicates that no representations have been made that the Dyestuffs Development Committee has not pursued an active policy in promoting the development of the industry. It is asserted indeed that the Committee is now engaged in a very careful survey of the precise extent to which British manufacturers are in a position to meet the requirements of British consumers of dyestuffs, so that the lines of progress may be marked out.

SOME RAILWAY ROLLING STOCK FOR AT HOME AND ABROAD

CAMMELL LAIRD AND CO., LIMITED, NOTTINGHAM, ENGINEERS

(*For description see opposite page*)



1.—40-Ton Bogie Hopper Wagon for the Bengal Nagpur Railway. 2.—20-Ton Iron Ore Hopper Wagon for the North Staffordshire Railway. 3.—Covered Goods Wagon for the Commissioners of the Port of Calcutta. 4.—20-Ton Oil Tank Wagon for the Great Indian Peninsula Railway. 5.—All-Steel Controller Trailer Car for the London Underground Railway. 6.—Third-Class All-Steel Coach for the Great Indian Peninsula Railway.

The Nottingham Works of Cammell Laird and Co., Limited.

PROBABLY the greatest task which has confronted the leaders of British engineering industry during the past three years, and a task still awaiting a complete and perfect solution, has been the reconstruction of works and plant, and the transmuting of the assembled experience of the war years to meet the new demands of our present time. More especially is this true of those large firms whose interests were predominantly associated with naval construction and the manufacture of armaments.

Although possessing a large and successful shipyard and engineering works of their own at Birkenhead, it became necessary for Cammell Laird and Co. to seek new outlets for the products of their steel works and tire and spring departments at Sheffield and Grimesthorpe, and to absorb some of the output of their newly planned steel and tire works at Penistone, which are now rapidly approaching completion. The construction of railway rolling stock undoubtedly opens a wide field for such developments, because of the increasing adoption of all-steel wagons and coaches, and the important part which the adoption of larger and better designed wagons must inevitably play in reducing the cost of transport to a strictly economical basis.

With such considerations doubtless in view Cammell Laird and Co., besides acquiring a large interest in the Midland Railway Carriage and Wagon Works at Washwood Heath, Birmingham, decided to purchase from the Government the Nottingham factory which they had erected in 1915, and subsequently managed, and to equip it as a thoroughly up-to-date railway rolling stock works. The original lay-out of the factory was designed for the production of 9.2in. and 6in. shells, and in 1917 an entirely new equipment was installed for the manufacture of 18-pounder and 6in. Mark XIX. guns, and for the repair of 9.2in. howitzers.

An interesting event took place on Friday last, when a large party of railway engineers inspected the factory and the working of the plant was demonstrated, and we had the pleasure of being present on that occasion. A special train from London was provided to take the guests to and from the works, and excellent arrangements were made by Cammell Laird and Co., who were ably represented by the chairman, Mr. W. L. Hichens, and the managing director of the Nottingham works, Mr. A. S. Bailey, in addition to other directors and officials.

The present equipment of machinery is for the most part entirely new, and includes not only those machines commonly used in carriage and wagon work, but also special machines of the latest type and of original design. Among the most interesting are some tools originally introduced for gun work which have now been ingeniously adapted for specialised operations in the preparation of component parts for wagon building.

Situated alongside the Midland Railway main line, the site of the works is one that enjoys unusual facilities for the supply of raw material and for the dispatch of the finished products. The total area of the site is about 43 acres, or enough to allow of the extension of the present buildings as necessity arises. The works shown in the accompanying plan occupy about half the site, and consist in the main of one large building covering a total area of about 10 acres, where the actual construction of rolling stock is carried on. An adjacent building is used as a woodworking shop for the preparation of packing material and for furnishing any woodwork required in construction, although in the wagons now being built the amount of wood used is very small. The factory has its own boiler and power-house built adjacent to the works. The offices are separated from the main works by Kings Meadow-road, and alongside them are situated the canteens and institute, the latter being one of the most recent additions in connection with the firm's welfare work, which has been continuous during and since the war. The general lay-out was originally designed to secure a large and rapid output, and this feature has been retained and developed in the new programme. Ample provision is made for the transportation of material inside the works, by overhead electric cranes, by electric trolleys which travel from section to section across a concrete floor, and by the rail tracks which traverse the north, the centre, and the south of the works, see Fig. 1. The centre track roughly bisects the main building, the forge, machine shop, and press shop being situated to the north of it, and the assembling and erecting shops to the south. Materials therefore enter on the north side, and after passing through the various necessary operations, are collected for erection and dispatch on the south side, while the programme of work is arranged so that operations may be synchronised and the various parts of a wagon may arrive for erection at the same time and in the same place. The organisation of the sequence of work is facilitated by the fact that the actual construction of rolling stock is carried on under one roof—see Figs. 3 to 6, page 272.

On the occasion of our visit to the works, in addition to the ordinary work in progress, arrangements were made to show the working of some tools employed on a large order recently carried out. The design and specification of this order were such as to admit of the introduction of certain novel and distinctive devices in the course of manufacture. These led to considerable development in the practice of multiple punching, by which an exceptional degree of accuracy was obtained, the fairness of the holes on assembly greatly facilitating the work of erection. Some of the outstanding features may be briefly noted. The structural drilling section of the shops is shown in Fig. 4. Here templates and jigs find extensive use in connection with the work of the multiple drills. For drilling the long supporting channels for the underframes a jig supported at its ends on trunnions is used, so that the channel may be drilled on three sides without being moved on the machine other than by turning. A supply of channels is placed in such a position that they may easily be fed to the machine, and the completed member falls on to an inclined roller platform, which obviates unnecessary lifting. Some interesting machines were seen in the heavy and light pressing sections. In many cases the hydraulic presses used had been originally employed for other work, and later altered by fitting special beds, to carry out the combined operations of shearing and punching without any change of set-up. By making slight alterations the machines are also capable of working various forms of plates and angles.

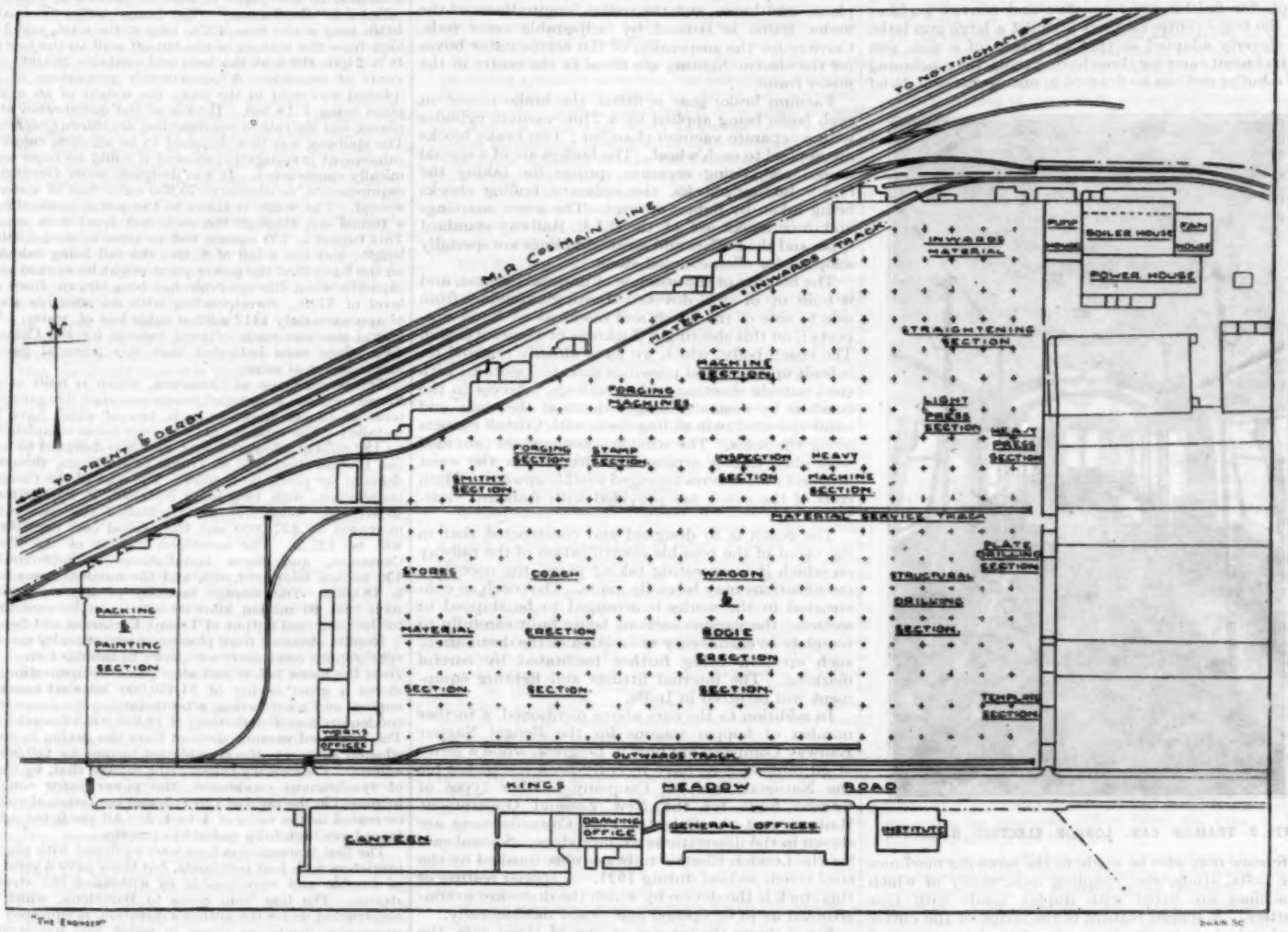


FIG. 1—SKETCH PLAN OF CAMMELL LAIRD AND CO.'S NOTTINGHAM WORKS

C f special interest was the first unit of a mechanical forming press for cold pressing. This machine, when completed, will be capable of dealing with 40ft. members. In a sample of work shown, the advantages of cold pressing were clearly demonstrated. A piece of ⅜in. mild steel was set up into channel form 4in. by 10in. by 4in., and by a second operation the ends of the channel were notched and set up, making a box construction. The corners, after being electrically welded to the full thickness, are of fully 100 per cent. strength, and not only is the process cheaper, but the loss of tensile strength and the pulling of the metal due to heating for hot pressing is entirely obviated. The process of cold pressing may be applied with advantage to many of the parts required in wagon construction; the example shown was a side rail bracket used on Indian standard wagons.

The process of shearing has been largely developed, and has almost entirely displaced the dressing of plates and angles by planing. The capacity of the rotary shear for circular and irregular work was shown and the accuracy of close dimension shearing was demonstrated on a large guillotine shear provided with dowel stops.

The light press section also contains some interesting

presses by which the flange and the body of the wagon side plates are punched in one stroke. On the same machine, without a change of set-up, end plates flanged on three sides are similarly dealt with, all flanges being punched simultaneously. In adapting these machines, the designer has displayed great ingenuity, it often being necessary to arrange punches to operate successively so as to avoid overloading the press where simultaneous punching and shearing or a combination of the two operations takes place in the same machine. High-speed angle punching was illustrated on a Bertram press fitted with a long bed to take movable stops. In the light machine shop extensive use is made of gang mills and hollow mills for irregular forgings which are unsuitable for setting up in a lathe. A series of lathes from which the cone pulleys had been removed and replaced by a simple fast and loose pulley giving a uniform high speed were noted.

Among other specially equipped tools seen in the light machine shop a duplex vertical boring mill may be mentioned. This machine has fitted to its headstocks two tools of novel shape possessing a cutting edge of 6in. to 9in. long parallel to the rotating bed of the machine. With this arrangement the machining of irregular shaped pressings, such as the triangular end supports for the hopper wagon shown on page 268, can be expeditiously carried out. Special lathes included turret machines with Gisholt forming tools for finishing the concave and convex surfaces of the bogie centre castings; whilst a large gun lathe is cleverly adapted so that by means of a slide rest attachment carrying three former tools, the machining of a buffer end can be finished in one operation. Brief

FIG. 2—TRAILER CAR, LONDON ELECTRIC RAILWAYS

reference may also be made to the screwing machines for bolts, studs, and coupling rods, many of which machines are fitted with duplex heads with four cutters. A special feature is the shape of the cutter tool, which is in the form of a flat chaser grooved on its upper surface from end to end and fixed tangentially to the metal being screwed. These tools have the merit of being easily sharpened and re-set, and can be used along the entire length of the tool. The equipment of the forging and stamping department is very complete, a well-chosen group of drop stamps, pneumatic hammers, forging and upsetting machines being used. The machines are well served with oil-heated furnaces of the latest type, and continuous high-speed saws for cutting off where this operation is required. A particular example of work shown was a coupling forging of the centre hook type finished complete in seven operations. Passing on from the machine, forge and pressing shops, the component parts are examined in the inspection department before being handed out for assembly and erection. A feature of this department is the excellent service of overhead cranes worked by hand control from the floor level, enabling material to be quickly handled and lifted in and out of the jigs and testing frames.

In the assembling and erecting departments—Figs. 5 and 6—an extensive use is made of both hydraulic and pneumatic riveting appliances, the factory plant having recently been reinforced to supply these power services. Portable oil-fired rivet-heating furnaces are largely used. An important feature of the work of erection is that the design is so planned and carried out that when once the main members of a coach section are framed together, all subsequent panels and angles may be clamped on and drilled and riveted in place. The work in progress provided a good illustration of this method. In the building of railway rolling stock, particularly coaches of the passenger type, it is very desirable that the external finish should be good. Finish is largely dependent on the riveting, and for this reason in the method used at Cammell Laird's all rivets for panels and framing are driven from the inside, the outer edge of the hole being countersunk and a flat finish requiring very little cleaning up is obtained by using a holder-up of the portable magnetic type. Of particular interest are the series of forty steel bogie coaches now being constructed for the Great Indian Peninsula Railway, and shown on page 268. The principal dimensions of the coach are as follows:—Gauge, 3ft. 6in.; length over headstocks, 67ft. 10½in.; length over buffers, 71ft.; bogie centres, 48ft.; bogie wheel-base, 10ft.; diameter of wheels, 3ft. 7in.; size of journals, 9in. by 4½in.; height of rail to centre of buffers, 3ft. 7½in.; height of rail to top of roof, 12ft. 9½in.; width overall, 10ft. The bogies are of the swing bolster type, the bolster being mounted on coil springs. The bogie frame is built up of steel plates and rolled sections securely riveted with steel gussets and knees, and is supported from the axle-boxes by laminated bearing springs with auxiliary coil springs. The under frame is built up from rolled steel sections riveted with plates and knees, and the centre longitudinals of the under frame is trussed by adjustable cross rods. Carriers for the suspension of the accumulator boxes for the electric lighting are fitted in the centre of the under frame.

Vacuum brake gear is fitted, the brake power on each bogie being applied by a 21in. vacuum cylinder with a separate vacuum chamber; two brake blocks are applied to each wheel. The buffers are of a special design comprising separate springs for taking the heavy buffing shocks, the ordinary buffing shocks being taken by lighter springs. The screw couplings and draw hooks are of the G.I.P. Railway standard type, and the buffers and screw couplings are specially adopted for close-coupled stock.

The flooring of the coach is of unusual interest, and is built up of steel dovetail sheeting extending from side to side of the coach and mounted on wood supports; on this sheeting a thickness of Decolite is laid. The coach body, which we have already referred to, is built up from steel pressings and steel sections with steel outside sheeting and mouldings. Access to the coach is by means of hinged doors at the ends, and hand-operated twin sliding doors with Crittall runners along the sides. The window openings are provided with glass frames arranged to drop below the waist rail, and with louvres arranged to slide upwards. Both ends of the coach are provided with standard vestibules.

The coach is so designed and constructed that in the event of the possible electrification of the railway on which it is operating taking place, the necessary modifications may be easily made. The coach as constructed in the works is arranged to be shipped in sections, the various sections being built carefully to template to ensure easy re-erection at the destination, such erection being further facilitated by careful marking. The internal fittings and lighting equipment will be fitted in India.

In addition to the cars above mentioned, a further number of hopper wagons for the Bengal Nagpur Railway Company are now in progress, while a series of oil tank wagons have recently been completed for the National Fuel Oil Company. Other types of wagons built for the New Zealand Government Railway and the Calcutta Port Commissioners are shown in the illustrations we reproduce. Several cars for the London Electric railways were finished by the steel coach section during 1921. A special feature of this stock is the device by which the doors are so constructed as to be opened and closed mechanically.

Fig. 2 shows the interior of one of these cars, the complete vehicle being illustrated on page 268. The capacity of the works for rapid and efficient construction is demonstrated by the fact that since the factory was started in 1920 upwards of 3000 wagons and cars have been completed, this programme having been carried through in spite of the difficulties of the coal strike period and the shortage of material caused by the closing down of rolling mill plants.

The Institution of Civil Engineers.

"HYDRO-ELECTRIC INSTALLATIONS OF THE BARCELONA TRACTION LIGHT AND POWER COMPANY."*

By Horace Field Parshall, D.Sc., M. Inst. C.E.

The more important installations are situated on the Pallaresa river at Talarn and Tremp, at Camarasa, and at Seros on the River Segre, a branch of the river Ebro. The dam at Talarn, like the Camarasa dam, is built on the gravity principle, so that the unbalanced vertical weight component on the upstream face of the dam is equal to the hydrostatic pressure. It is 262ft. long at the base, 670ft. long at the crest, 269ft. high from the main floor to the crest, and approximately 328ft. from the bottom cut-off wall to the crest, and it impounds about 7760 million cubic feet of water. The disposition of the different grades of concrete used in the dam to meet the requirements of the Government officials is indicated in a figure.

The Tremp power-house, which derives its power from the Talarn dam, is equipped with four 7000-kilowatt horizontal-type turbo-generators, one turbine at each end of the generator. The average annual flow of the river Pallaresa over a period of years is about 49,100 million cubic feet, and the output of this power-house in normal years is about 110 million kilowatt-hours. At high-water level the working head is 249ft., and at lowest level it is 118ft. The latter condition, however, has not arisen, the turbines being invariably worked at the higher levels. The general results for the year 1917 show an overall efficiency of about 72 per cent., or a water consumption of 259 cubic feet per kilowatt-hour with a head of 196ft. to 229ft. The water utilised in an average year at this power-house is 26,593 million cubic feet. The cost of the Talarn and Tremp installation was £1,826,700, details of which are given.

The installation at Aytona, or Seros, on the river Segre, of which the rivers Pallaresa and Ribagorzana are tributaries, was the first constructed. The water is taken to the power-house by a canal 12 miles in length, while the diversion dam is at Lerida. The power-house is designed to accommodate five vertical-type generating units of 8000 kilowatts (four of which have been installed), and is designed to work with 160ft. head, the output being in an average year 130 million kilowatt-hours. The cost of this installation is approximately £1,852,260.

The most important and more recent installation described in the paper is that at Camarasa, sometimes called the "Confluence." The dam at Camarasa is about 105ft. long at the base, 492ft. long at the crest, and 318ft. high from the bottom of the cut-off wall to the footway. It is 246ft. thick at the base and contains 280,000 cubic yards of concrete. A considerable proportion of rock (plums) was used in the dam, the weight of an average plum being 1.18 ton. Details of the distribution of the plums, and the rate of construction, are shown graphically. The spillway was first designed to be an open canal, but subsequent investigation showed it could be more economically constructed. It was designed under Government requirements, to discharge 70,600 cubic feet of water per second. The water is taken to the power-house through a tunnel cut through the rock and lined with cement. This tunnel is 750 square feet in cross section, 738ft. in length, and has a fall of 8.8ft., the fall being calculated on the basis that the power plant might be worked at full capacity when the reservoir has been drawn down to a level of 370ft., corresponding with an effective storage of approximately 1412 million cubic feet of water. Very liberal use was made of sand cement for the Camarasa dam, since tests indicated that this material gave an ample factor of safety.

The power-house at Camarasa, which is built of reinforced concrete, is designed to accommodate five generating units of 12,500 kilowatts each, two of which have been installed. The capacity of this power-house completed will be 182 million kilowatt-hours, and it is designed to utilise the 12-hour discharge at Tremp in six hours, should the demand for power so require. The cost of the Camarasa installation, with two units installed, is approximately £1,370,776. With five units installed the cost will be increased by £375,000 and the capital cost per kilowatt will be £27.9. The combined output of the Tremp, Camarasa, and Seros installations is approximately 430 million kilowatt-hours, and the nominal horse-power is 180,000. The storage capacity of the reservoirs is such that 90 million kilowatt-hours can be contributed to the combined output of Tremp, Camarasa and Seros.

Results obtained from phase-compensation by means of synchronous condensers are shown in tabular form. This gives the losses before and after phase-compensation, and shows a gross saving of 24,450,000 kilowatt-hours per annum, and a net saving, after deducting the losses in the condensers and distribution, of 18,950,000 kilowatt-hours. The increased revenue derived from the saving in energy effected augments the possible net income by £80,000 per annum. Preliminary calculations showed that, by the use of synchronous condensers, the power-factor could be increased in the ratio of 1 to 1.3, and the terminal voltages increased in the ratio of 1 to 1.2. All predicted advantages have been fully realised in practice.

The first transmission lines were equipped with pin type insulators with four petticoats, but these gave a great deal of trouble and were unable to withstand the stress of storms. The line from Seros to Barcelona, which was constructed under the author's direction, is equipped with suspension insulators, seven in series, and has stranded conductors of 250,000 cir. mils section. The line from Camarasa to Igualada has been reconstructed in order to use the suspension type of insulator, and it is equipped with six in series, of the Howlett type. The standards are designed for straight runs with average spans of 650ft. They are equipped with two lightning guard wires of ⅜in. diameter, and are designed to withstand a wind-pressure due to a velocity of 100 miles per hour with ½in. of sleet on the wires, the towers to remain stable with two wires broken.

Particulars of steam and hydraulic generation at the several stations are given for the years 1917, 1918, 1919 and 1920 respectively. The results in an average year of Tremp and Camarasa are compared, allowance being made for the different features of the two installations, and particulars of the plant, kilowatt-hours generated per annum, annual river flow, water utilised, mean head, average effective head, efficiencies and water consumption, &c., of the two plants are given, as determined by measurement and test. The drawings show, in addition to these installations, a number of minor installations and particulars of some others that have been in contemplation, but have not yet been built.

* Official abstract of a paper read before the Institution of Civil Engineers, on Tuesday, February 7th, 1922.

Ferranti Staff Annual Dinner.—The tenth annual dinner of the staff of Ferranti Limited was held on Friday, March 3rd, at the Midland Hotel, Manchester, and was followed by a dance. The chairman of the company, Mr. A. W. Tait, received the guests and presided over the dinner. The usual toasts were interspersed with musical items. Dancing followed, and was continued until the early hours.

Railway Matters.

THE resignation, owing to ill-health, is announced of Mr. C. Cumming, the locomotive, carriage and wagon superintendent of the Highland Railway. The directors are seeking for a successor.

THE East Coast up day Scottish express ran into a herd of bullocks when between Goswick and Beal on the North-Eastern Railway on Monday morning last. The engine and several coaches were derailed, but there were few personal injuries.

THE revenue receipts on the Victorian Railways for the half-year ended December 31st last were £5,111,605, as against £4,579,243 for the same period in 1920. With the exception of live stock revenue, all earning sections of the Department increased their receipts.

THE *Gazette* announces that a preliminary scheme for the amalgamation of the North-Eastern and Hull and Barnsley Railway companies, framed in accordance with the Railways Act, 1921, has now been submitted to the Minister of Transport for reference to the Amalgamation Tribunal.

THE Railways Amalgamation Tribunal will hold a public sitting at 7, Whitehall-gardens, on the 20th inst., to consider the preliminary scheme for amalgamation submitted to the Minister of Transport by the Great Western Railway and the constituent companies in the Western Group.

JUDGING by what the Chancellor of the Exchequer had to say on the 1st inst., the proposals of the Geddes Committee as to the Ministry of Transport have been shelved, in view of the fact that the creation of a Ministry of Communications, which should embrace the Ministry of Transport and the Post Office, is under consideration.

THERE will be five, six and nine-day excursions at Easter to practically all parts of Great Britain, leaving on Thursday before Good Friday and available for return on Monday, Tuesday, or Friday in the following week. Fares for these excursions will be at the rate of one and a-third the amount usually payable for a single journey.

THE Maryport and Carlisle Railway is to be absorbed, as one of the subsidiary companies, in the North-Western, Midland and West Scottish group. The Maryport Town Council wishes the railway to be absorbed in the Eastern group as giving a clean cross-country run from the Solway to the Tyne and promising development of the trade with Ireland, Liverpool and the East Coast.

THE North Staffordshire Railway chairman said the other day that the amount of coal sent from that line to other companies' systems during the week ending February 18th was 42,414 tons—the largest amount since August, 1917. The Cleator and Workington Company also reports that five furnaces are now in blast; the steel works have been restarted and the coal pits are working regularly.

THE annual report of the Metropolitan District Railway Co. observes in its opening statement that the Government control of that system ceased on August 15th last, but, as was remarked in the report for 1920, the responsibility of the Government for the net revenue of the company ceased on September 26th, 1920. The company has no outstanding monetary claim against the Government except for stores.

As announced in this column on the 24th ultimo, the Irish railway companies and their men have adjusted their differences, and have made an agreement which is to remain in force for six months. The Press announcement as to this agreement added that "in the meantime a Government inquiry will be set up and an exhaustive inquiry instituted with the entire working of the Irish railway systems."

A FEAT of considerable engineering skill in Sydney is marked by the opening of the Roselle Bay–Darling Island railway line for traffic. Some years ago it was decided to effect a deviation, involving the construction of a large viaduct over low-lying ground and a tunnel under Glebe-road. Nearly £1,000,000 has been expended, but the deviation is an important one, and brings within sight of completion the entire scheme for the relief of the main suburban passenger line of heavy goods traffic.

THE Great Central Company has had occasion to go to the Railway and Canal Commission about its through carriage from Marylebone to Halifax. This vehicle used to be detached from the Bradford portion at Huddersfield, and taken forward by the Lancashire and Yorkshire. Since the latter has become part of the London and North-Western system, the Halifax connection has been dropped. It has now, by agreement, been restored and the Court, on the 21st ultimo, made an order accordingly.

THE last annual meeting of the Cambrian Railway Company brought out many compliments to Mr. S. Williamson, the general manager. Few people, said Major David Davies, the chairman, could realise the calm devotion, the long-suffering patience, and the quiet determination which he had displayed throughout a long and trying period in the history of the company. The progressive improvement in their fortunes during the last ten years had been largely due to his persistent efforts, to his zeal for economy and efficiency, and to the spirit of self-sacrifice and devotion to duty which had characterised all his efforts.

SPEAKING on the 24th ultimo at the annual meeting of the Great Eastern Railway, Lord Claud Hamilton said, with respect to the Eastern, North-Eastern, and East Scottish group, that with all the ports, except one, on the East Coast under its command, and with Germany and Russia settled down, an enormous trade would develop. But to his mind—and he spoke only for himself—the chief benefits to be derived from grouping were the vast economies which should be effected under strong and capable management. Lord Claud proceeded to say: "Let no mistake be made at the commencement. The chairman of the whole group should be a man in the prime of life, of proved capacity, and with railway knowledge, prepared to give the whole of his time to the execution of his duties. Such a man must be highly paid, and if you get the right man the question of the amount of his salary is of minor importance."

Notes and Memoranda.

A NEW type of glass is being manufactured in Birmingham which is said so to modify the light emitted by half-watt electric lamps that it resembles daylight.

A TEXTILE material has been produced, according to the *Chemical Trades Journal*, which is unusually resistant to the action of acids and will even withstand the attack of strong sulphuric acid.

IN the course of a review of the industrial resources of Newfoundland, Captain E. J. Edwards, H.M. late Senior Trade Commissioner in Canada and Newfoundland, says that in considering the development of the mineral and other resources account should be taken of the water powers of Newfoundland, which are very considerable, though up to the present comparatively little has been done to develop and utilise them. Endeavours were being made at the time the report was written to interest United Kingdom capitalists in one particularly attractive water-power project.

A ROUGH determination of the resistance of a refractory to the corrosion of a slag, dust or ash may be effected, according to Mr. W. J. Rees, lecturer on refractories at the University of Sheffield, by drilling a hole in the material, filling it with the slag or ash and heating under predetermined conditions. It is, however, better to cement on to the face of the brick a clay ring and fill this with the slag or ash, as the face or skin of the brick is not then removed. The lower porosity of the face of the brick may reduce the speed of the corrosion. The porosity of the brick is an important factor in the resistance to both abrasion and slag penetration.

M. GEORGES CLAUDE, the inventor of a process for producing synthetic ammonia, has introduced a modification into his method, which, he claims, has improved it considerably. He has found that it is no longer necessary to heat the gases with which he carries out the process before introducing them into the apparatus, as the heat of reaction is sufficient to raise the temperature of the gases to the degree at which the reaction takes place under the most favourable conditions. The heat produced by the reaction, and utilised in this way, no longer proves injurious to the apparatus, and the danger of explosion has, it is stated, completely disappeared.

THE first number of *Engineers and Engineering*, which is a continuation of the *Journal* of the Engineers' Club of Philadelphia, contains an interesting article by Mr. Ralph Modjeski on the proposed Delaware River bridge, in which he advocates the use of wire cables, rather than eyebar chains, for suspension bridges of large span. A properly constructed cable, galvanised or not, is, he says, more proof against rust than a group of eyebars packed closely together on a pin. When the increasing live loads on the International Railway suspension bridge over the Niagara River required its replacement by the present bridge, the old cables were found in the same state of preservation as when placed there fifty years before, and when cut apart the wires tended to return to their original coil. These wires were not galvanised.

IN the course of a recent lecture on cement, at Newcastle, Dr. C. H. Desch said that it did not seem possible to reach a much higher temperature in rotary kilns at the present time. The only suggestion made in respect of raising the temperature is that one should actually melt the material. That would mean using something like a blast-furnace temperature, but the ordinary blast-furnace would not do. It might be got electrically, and it had been suggested by the late Mr. Blount that one might use blast enriched by oxygen. That was quite a practicable suggestion, as oxygen was quite a common commercial substance now. In that case one might be able to melt the product and thus get equilibrium instead of a merely clinkered product. If the reactions were carried further they would get a most active cementing material.

TRIALS conducted by a Belgian firm have shown that a two-cycle engine of the semi-Diesel type, known as the "Drott" and made by a Swedish firm, can be successfully used with palm oil. The "Drott" engine used in the trials was of the stationary type, and was adapted, but not specially designed, for use with palm oil. It was equipped with a storage tank for the oil, so fitted that the cooling water from the cylinder and the hot exhaust gases melted the contents. The tank was divided into three compartments by wire screenings, through which the melted oil filtered before entering the feed pipe. The engine was started from the cold with crude petroleum, and as soon as it was warmed sufficiently the petroleum supply was cut off, and the palm oil introduced through the automatic feed. Water was also injected automatically.

SPEAKING at a meeting of the Institute of Marine Engineers on the subject of grey iron castings, Mr. H. J. Young suggested that grey cast iron is a very high carbon steel cut up by and surrounding innumerable plates of graphite, that is, a matrix of steel containing many spaces filled with graphite—for this reason can cast iron be machined, the non-homogeneous material collapsing under the stresses produced by the edge of the cutting tool; for the same reason also has it little or no elongation and many other properties peculiar to itself. A practical object lesson of the truth of these things is obtained from a large propeller casting, blades and boss complete, and weighing, say, 11 or more tons. Here the great mass of the boss causes extremely slow cooling of the adjacent parts, the effect getting less and less along the blades away from the boss and also the section of the blades themselves gets less. In practice, the molten metal flowing to the tips of the blades is almost chilled and, therefore, the tips are very hard and brittle and contain but little free carbon. A short distance from the tip this cooling is less severe and more carbon is released, with the consequence that the metal is grey but rather hard. Half-way up the blade the section is greater and the heat given off by the cooling of the boss delays the cooling, hence the metal will be very normal and perfectly grey and machinable. At the root of the blade, where it joins the boss, the cooling will be extremely slow. The iron has time to free itself almost entirely from combined carbon, and when cold is found to be full of large graphite.

Miscellanea.

IT has been decided to reopen forthwith the Threlkeld lead mines, Cumberland, which have been closed for twelve months, largely as the result of severe competition from Government supplies of zinc concentrates from Australia, zinc concentrates representing about half the product of the Threlkeld mines.

ACCORDING to estimates recently published by the Dominion Water Powers Branch of the Canadian Department of the Interior, the total capacity of the water-power installations at present constructed throughout the Dominion is about 2,418,000 horse-power, of which 2,215,000 horse-power is actually and regularly employed. The ultimate capacity of plants now operating or under construction totals 3,385,000 horse-power, and the capital invested amounts to more than 400,000,000 dols.

AT the forty-fourth annual general meeting of the Institute of Chemistry, held on March 1st, the President, Mr. A. Chaston Chapman, F.R.S., presented the first Meldola Medal to Dr. Christopher Kelk Ingold. The medal, which is the gift of the Society of Maccabaeans, has been instituted as a memorial to Professor Raphael Meldola, a Past-president of both the Institute and the Society, and is awarded for meritorious original work in chemistry conducted by British subjects under thirty years of age.

ACCORDING to the second annual report of the British Non-ferrous Metals Research Association there has been an extraordinary increase in membership during 1921, over 100 firms now subscribing to the Association, including all the members of the chief trade associations in the non-ferrous industry. The Council works through Committees for research and publications, and has a well-equipped information bureau for the benefit of members. The electric melting of non-ferrous metals has hitherto received less attention in this country than in the United States, but it is gratifying, says the report, to see that that important matter is not being neglected.

MR. KELLAWAY states in Parliamentary papers that the delay on the Eastern Telegraph Company's cables to India has been due to the large increase of traffic since the war and the continued interruption of the land routes to India and the Far East. To meet the pressure the company laid a new line of cables between this country and Singapore in 1920, and it proposes to lay another line to Singapore in the near future. The "urgent" service was introduced as the result of representations from the commercial community, and, while the delay remains abnormal and an "urgent" service is available in foreign countries, Mr. Kellaway says that he does not think it would be in the interests of British cable users to abolish it.

ACCORDING to reports from Stockholm, the Swedish Shipowners' Association is petitioning the Government for a grant of Kr. 5 000,000 for shipbuilding at Swedish shipyards with Swedish material with a view to arresting the dangerous state of stagnation developing in the Swedish merchant fleet. The Association proposes that the grant be at the rate of Kr. 100 per ton, and calculates that a sum of Kr. 5,000,000 would render possible the construction of three motor ships of 10,000 tons each and three of 6700 tons, twelve steamers of 3500 tons, twelve of 3000 tons, twelve of 2500 tons, and twelve of 1000 tons. In order to prevent these ships being sold abroad the Association recommends that such sales should be prohibited for a period of five years after building is completed.

THE Secretary for Mines gives notice that the following types of breaching apparatus have passed the official tests, and that the Board of Trade have decided to approve these types in pursuance of No. 11 of the General Regulations dated July 30th, 1920, for use at rescue stations and mines:—(1) The Meco-Briggs rescue apparatus, manufactured by the Mining Engineering Company, Limited, Meco Works, Moorfields, Sheffield; and (2) the Paul mine rescue apparatus, manufactured by the American Atmos Corporation, Wilkinsburg Works, Pittsburg. An approving order, containing a specification and drawings of each of these types of apparatus, is in preparation, and will be made and published shortly. The Meco-Briggs type of apparatus as approved differs from the type of Meco apparatus now in use in mines.

MEMBERS and officials of the Birmingham City Council and representatives from neighbouring authorities attended a demonstration, at Holliday-street, recently, of a new sprinkler, road sweeper, and refuse collector. This "Karrier" motor vehicle carries at the front a sprinkler, and a brush, operating tangentially, sweeps the road well beyond the track of the road wheels, so that the thoroughfare can be swept right up to the kerb. The refuse is swept to the off side of the vehicle, and a rear brush transfers it to a pan and conveyor. The employment of further vehicles and men to gather up and remove the refuse to the tip is thus obviated, as the sweeper, its hopper full, conveys the refuse automatically gathered to the tip, a special apparatus being provided for easy discharge. The sweeper is reported to have made a good job of the work given it to perform.

IN an explanatory summary attached to the report of the Wireless Telegraphy Commission it is stated that after a visit to the Marconi Company's station at Carnarvon the conclusions drawn are, firstly, that the installation at that station is approaching the order of magnitude required in the chain stations; and, secondly, that the Marconi Company is in a position to supply full-size thermionic equipment for the chain stations. The Carnarvon station has succeeded in communicating with Australia direct at certain hours of the day, and therefore it is certain the chain station in England, which would be three or four times the signalling strength of the Marconi station, could communicate with Australia throughout a longer diurnal period. The Commission recommends, among other things, that thermionic valve stations should be erected in England, Canada, Australia, South Africa, and India. A thermionic valve station should also be erected in Egypt to duplicate the arc station now being completed by the British Post Office at Abu Zabal. At each of the other centres—namely, East Africa, Singapore, and Hong Kong, an arc station should be erected with space for the addition of thermionic valve plant later.

RAILWAY ROLLING STOCK FACTORY AT NOTTINGHAM

CAMMELL LAIRD AND CO., LIMITED, ENGINEERS

(*For description see page 269*)

FIG. 3—GENERAL VIEW OF SHOPS, LOOKING WEST

FIG. 4—STRUCTURAL DRILLING SECTION

FIG. 5—ASSEMBLING SECTION

FIG. 6—ERECTING SECTION

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Letters relating to Advertisements and the Publishing Department of the Paper are to be addressed to the Manager, all other letters to be addressed to the Editor of The Engineer.

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THE ENGINEER.

MARCH 10, 1922.

A Commercial President.

It is perhaps no more than a coincidence that the President of the Institute of Metals, who entered upon his duties on Wednesday last, is a commercial man. No doubt it was Mr. Leonard Sumner's turn to take the chair. But Fate has a curious way of ruling these things, and she—acting, of course, through the Council—may have decided that now, when the immediate recovery of trade is even more necessary to the country than the advancement of science, is the fitting time for a commercial man to hold the tiller of a scientific institution and bring it down from the high æther into which it sometimes soars to the affairs of the market-place. The experiment will be an interesting one. For a year at least the Institute of Metals, if its new President keeps a firm hold of it, will have to think more about the buyer and the seller than has been its wont, and will find itself more often brought up against the practical issues of the mart and drawn away from the fascinating and absorbing problems of the laboratory. Frankly, we are sure the treatment will do it no harm. The proper vocation of our learned institutions is the *science* of industries, but just for once in a while it does them good to get down into the arena and find themselves jostled and buffetted in the struggle for trade. After all, the bulk of the members of our engineering societies live by the sales of materials, and to see how those sales are conducted can neither be valueless nor uninteresting to them. Mr. Sumner suggested in his presidential address that some of his hearers might consider "commercial aspects" as "the rather sordid side of industry." We do not suppose any one of them did anything of the kind, and we should like to make the gentlest protest, on behalf of scientific men, against the oft-made assumption that because they do not take an interest in trade they look down upon it. With justice they might retort to the trader that he, because he does not interest himself in science, scorns it. We cannot suppose that even Faraday—of all pure scientists the most pure—looked upon the material applications of his great discoveries with anything less than pleasure, or that he would have regarded the management of the vast industry that has been built upon them as sordid.

We give on another page long extracts from Mr. Sumner's address, and readers of them will not fail to notice that one of the first tasks which the commercial President imposed upon himself was the defence of manufacturers. "It has been said," he observed, "that manufacturers do not contribute papers nor take part in discussions as they should—in other words, that they do not take their share in imparting knowledge." Why they do not he showed by an example. Broadly, the answer is that the manufacturer's first concern is to earn dividends for his shareholders, and if he thinks he can keep a valuable secret to himself he does so. We were sorry to find the President palliating this offence rather than opposing it. The more that is learnt of trade secrets the more evident does it become that the benefit they give is of a temporary and short-lived nature, and that the harm they do continues during their existence and often long afterwards. In the particular example quoted by Mr. Sumner the firm that withheld its knowledge may have secured a slight advantage over its home competitors, but in the end might injure its own trade by allowing the bulk of the British industry to be discredited. There can be no doubt that in the long run more good is done by the dissemination of knowledge than by the restraint of it. Suppose, for example, that there is enough trade for ten firms, and that one firm alone holds the secret. It does not get all the trade because it cannot give sufficiently quick delivery, and some of it goes abroad. If, now, the firm reveals its trade secret, then other manufacturers may get some of the work, and because rapid deliveries are made possible trade develops, the foreigner does not get in, and even the first firm is better off than before. The effect of trade secrets is similar to the effect of patents for inventions—they check development. "Compulsory licences" have been introduced to correct the ill-effects of patents; it would be well if "compulsory revelation" of trade secrets could also be enforced. Mr. Sumner, indeed, suggested one way in which they are likely to be removed. He attacked the use of "fancy" names for materials of unspecified compositions. "I am bold enough to assert," he said, "that the time is coming when no 'Jones's Metal' or 'Smith's Bronze' will be accepted by the user unless the manufacturer is prepared to lay his cards on the table and say at once what his alloy consists of." But Mr. Sumner recognises that unless the purchaser knows something about metallurgy the information afforded by the specification will avail him but little, and he finds himself therefore forced to "emphasise with all the power" at his command the immediate necessity of engineers receiving metallurgical training. Poor engineers! It takes them six years to learn what they have to learn now, and Mr. Sumner wishes to add another load to their back, and a load, we protest, that they ought not to be invited to bear. The engineer should be no more under the obligation to know all about alloys than the purchaser of a pair of boots is under an obligation to know the process of tanning. It should be the duty of the producer of the metal, bronze or steel, we care not which, to provide material of a specified standard, suitable for the purpose for which it is intended. The purchaser's testing laboratory is a standing insult to the producer, and we hope to see the day when every laboratory of the kind is swept away and the guarantee of the manufacturer ensures the quality of the goods.

It will be seen that Mr. Sumner brought before the Institute of Metals new subjects for consideration, and obliged the Institute, as an institute, to look upon aspects of the work of its members to which hitherto it has paid little attention. He reserved till near the end of his discourse the matter which is, after all is said and done, the one most pregnant in the business world. Of the fundamental and basal importance of science in industry there can be no manner of doubt, of the necessity of advanced and intelligent technology there can be no question, but great as these two things are they cannot by themselves make trade. It is the man, and again and again the man, who does that. We, in this country, are spending great sums in educating youths in science and in commerce, but over and over again the same charge is made that we are failing to produce men of character. Indeed, there are not wanting those who say that the men without specialised training make good more often than those with it. "What do we who are in charge of commercial undertakings in the non-ferrous industry find?" exclaimed Mr. Sumner. Trained metallurgists, chemists, engineers in plenty there are, but the right man for managership is not to be found. "I would like," continued the President, "professors and teachers to ponder over the fact and ask themselves why it is that the students they have trained so carefully and with so much pains do not rise, generally speaking, to take those higher positions in the non-ferrous manufactures to which it would seem their training would eminently fit them." That is a problem of education which some day will have to be faced. We have so improved our methods of teaching science that we can with

facility turn out a few hundreds of competent scientists per year. But science without character will not push the world along. Is our method of teaching killing character, or are men without character, and never likely to acquire it, entering the fields of science because those fields have been made smooth; because any average intellect may acquire proficiency in everyday science? We have taught science and left character to chance, and the error of our ways is being made manifest to us.

"Fool-proof" Materials.

MODERN metallurgical advances have led to the development of an almost bewildering number of materials—of metals and alloys having widely different and, sometimes, almost incredible properties. That the availability of such an enormously extended range of materials is a very real advantage to the engineer cannot, of course, be questioned, but it brings with it unavoidable difficulties. One of these difficulties hinges mainly on the choice of the right material for a given purpose, and frequently calls forth interesting and suggestive differences of opinion, both between individual engineers of equal experience in a particular line of construction and between metallurgists who may perhaps be interested in the development of different types of materials. Differences of opinion of this kind are not to be wondered at in view of the fact that many of the materials are still comparatively new and that the amount of experience in their use is not yet great. Sometimes we meet with a case in which several different materials offer countervailing advantages and disadvantages, which together result in a very nearly equal balance where a selection has to be made. These differences of opinion and variations of choice, therefore, may be regarded as entirely healthy and indicative of active progress.

There is, however, another type of difficulty which is sometimes raised in regard to new materials, which is of a much less satisfactory type. It is the suggestion that some particular type of steel or alloy is not very desirable from the practical point of view because it requires "difficult and complicated" treatment—that its treatment is so "delicate" that it cannot be safely left to the ordinary workshops. This kind of opposition rests upon something of a misconception of the degree of skill and knowledge really required for the successful treatment even of the more "complicated" materials, for it is in reality a very simple matter to secure right treatment if it is once realised throughout the workshops that metals must not be heated, for softening or other purposes, except under well-defined conditions. Once this fact is realised, and actual heating is entrusted to a few persons who have acquired the rudimentary knowledge needed to ensure intelligent treatment, the whole difficulty must vanish and the task of both designer and metallurgist must be appreciably facilitated. For there can be no doubt that if we are to confine ourselves to materials which are more or less indifferent to heat treatment we must forego some of the most valuable achievements of the metallurgist. Some of these materials are only attainable by means of carefully devised and correctly applied heat treatment. Even if the engineer should find it a little difficult at first to secure the correct treatment of them, it is surely his task to overcome those difficulties rather than deprive himself of the use of them. Actually, it may be pointed out, even the simplest and oldest of our engineering materials are never entirely indifferent to heat treatment. In use, or rather during construction, they are frequently submitted to some very undesirable forms of treatment under the assumption that it does not matter. Actually, it matters a great deal more than is realised, and these materials are consequently often used in a condition in which they are less than half as resistant to the stresses acting upon them than they might be. But these materials are relatively very cheap, and mass is employed in the place of careful attention to quality and condition, and in that way a certain degree of "fool-proofness" is achieved. When more expensive materials are used, they are expected to "live up" to their higher powers of resistance to a much greater extent, *i.e.*, they are not only stressed much more heavily from the designer's point of view, but they are also employed in the worst places, where more or less unknown stresses have to be borne. In such circumstances wrong heat treatment makes itself acutely felt, and then the engineer is heard sometimes to grumble at the "sensitiveness" of the new materials.

We do not suggest that such aversion to the use of special materials requiring careful treatment is by any means widespread or general among engineers; otherwise the new alloy steels and new aluminium alloys would not be finding their way into practical use upon so large a scale. Nor do we lack sympathy with the man who has to control large workshops when he sighs for the "good old days" when such things as correct heat treatment were never thought of. Engineering progress, however, demands the use of ever-improving materials capable of bearing greater stresses and of allowing the reduction of weight. The whole development of the automobile and the aeroplane has emphasised this line of progress very strongly, and further metallurgical advances are certain to bring with them increased requirements in regard to careful treatment. The progressive engineer, or, indeed, any engineer who wishes his products to compete with those of progressive men in other countries, cannot afford to oppose this line of progress. His attitude should indeed be the very opposite, by welcoming every advance that the metallurgist can offer, and by acquiring, for his own part, an adequate control of his processes in such a way that he can adapt them to the needs of the new materials. Except for special purposes where cheapness of production apart from weight-saving or mechanical efficiency is to be regarded as the sole object, the demand for "fool-proof" materials should not be heard from enlightened and progressive engineers.

Literature.

A Story of Railway Pioneers, being an Account of the Inventions and Works of Isaac Dodds and his Son Thomas Weatherburn Dodds. By Major S. SNELL, M.C. (ex R.E.). London: Selwyn and Blount, Limited. 1921. 12s. 6d. net.

WHY is it that some men in their generation win fame and that their names are handed down to posterity, whilst others of equal or perhaps greater merits pass through their lives known to but few, and in their deaths are forgotten? Why are Trevithick and Stephenson remembered when Timothy Hackworth is little more than a name, and Isaac Dodds is wholly unknown? We believe the answer may be found in the single word individuality or personality. Let a man be never-so-clever, never-so-ingenious, if he have not that virtue which compels the attention of others, success will be denied him. "Geordie" Stephenson, looked at in the cold light of later knowledge, was not a greater inventor than some of his contemporaries. The Rocket locomotive, on which in the public eye his reputation rests, was hardly his at all. Trevithick led the way with the smooth wheels and the direct drive, the blast was used before his time, and first wholly understood by Hackworth, the tubular boiler was proposed by Séguin, and the Rocket was built by his son Robert and by Booth, with but little real help from him. The link motion was the invention of Howe. It was not so much Stephenson's superiority as a mechanical engineer as his force of character and his undaunted courage that won for him recognition and put in his way opportunities that, lacking it, he would never have enjoyed. Or rather ought we say that the man with character makes his own opportunities, for having won the confidence of his contemporaries they entrust him with work that they would withhold from others? History, too, conspires to hide the works of men who have failed to impress their age. Had Stephenson produced the locomotives Star and Monarch, records of them would have remained to us. Little more of them is known than their names, because Isaac Dodds designed them, and Isaac Dodds, despite his merits as an ingenious, courageous and successful inventor, failed to rouse the enthusiasm of his contemporaries.

It is in some such cause as we have endeavoured to indicate that we must look for the failure of nearly all the historians of the steam engine even to mention the works of Isaac Dodds. One invention, and one only, of his is remembered, his wedge excentric, and even it, though it survives to this day, is never known by his name, and would perchance have escaped record altogether had not Brunel favoured it for locomotives on the Vale of Neath Railway and thus led Zerah Colburn to devote some study to it. Dodds was born in the first year of the nineteenth century. Owing to the death of his father in a colliery explosion he was apprenticed at a very early age to his uncle, that Ralph Dodds who as chief viewer at Killingworth gave George Stephenson his first opportunity to make a locomotive, and was associated with him in the patent. Young Isaac saw the building of that famous engine, and according to his present, and only, biographer it was he who suggested the employment of coupling rods in place of the endless chain. Then only between the age of fourteen and fifteen, he busied himself, so Major Snell tells us, in the making of a model of the Killingworth engine, and finding difficulty with the chain he devised the coupling rods and demonstrated their action to his uncle with a couple of spinning wheels. The credit of the invention was given by Nicholas Woods to Ralph Dodds; his predecessor at Killingworth, and with him it has remained, though if the present author's story is well-founded the boy Isaac should have the honour. When, a few years later, in 1823, George Stephenson opened the Forth-street Works at Newcastle, he took Dodds, then twenty-two years of age, with him, and here, according to his biographer, the young man built a model locomotive with horizontal cylinders. Stephenson, we are told, rejected the design on the ground that the weight of the piston would wear out the cylinder. We wish here as elsewhere that Major Snell had given us the authority on which his statements are based. He tells us in his preface that he has had access to papers and interviewed many people. Interviews long after date are not to be trusted, and the only written evidence that can be accepted is contemporary. All else must be subjected to rigid examination. We have no means of knowing the quality of the evidence Major Snell has employed and cannot, therefore, express any views as to the accuracy of his statements.

Two years later this daring young man, we are told, started a little works of his own at Felling-on-Tyne, and there did much special work for Stephenson. In 1830 he was engaged as consulting engineer to the Monkland and Kirkintilloch Railway, and in that capacity designed two locomotives on the Killingworth model which were constructed by Murdock and Aitken of Hill-street, Glasgow. They had cylinders 10½in. by 24in., and a boiler pressure of 50 lb. with wheels 3ft. 3in. diameter. They were extremely successful, and according to Gurney, in his Treatise on Locomotives, were the first engines to employ metallic packing rings for the pistons. Major Snell briefly describes the ring, but he fails to tell us whence the particulars are derived. The description does not tally with a sketch—probably taken from a patent specification—which appears in a later chapter. It is worth recalling that Cartwright patented a metallic piston as early as 1797, and that Barton's piston was patented in 1816, and was largely used long before 1831.

Dodds did not remain long at Felling, for in 1832 he accepted the management of the Horsley Coal and Iron Company, Staffordshire, and there designed and built for South Wales a locomotive of which "the boiler was carried on two separate four-wheeled bogies, which also carried the cylinders and motion." It was immediately followed by the Star for the Liverpool and Manchester Railway. Why this engine has escaped attention it is difficult to say, for the designer claimed for it that "This was the first engine made with a solid plate frame; the first reversing motion controlled directly by a reversing lever, and the first arc or link motion with fixed centres, used; and also the first with a boiler free to expand on its frames." The engine, if we may trust its designer, presented many novel features, but probably the most remarkable is the fact that it is never mentioned amongst the names of L. and M. engines. The same fate dogs the Monarch, built at Horsley for the St. Helens and Runcorn Railway, from which it displaced the rope incline at St. Helens.

Dodds remained with the Horsley Company for five years and designed, besides locomotives and railway stock, several ingenious machines and ordnance of various kinds. He was one of the first engineers to appreciate the importance of accurate workmanship and the value of fully dimensioned working drawings. He left Horsley in 1837 at the request of his brother-in-law, John Stephenson, the contractor, to undertake the construction of the Sheffield and Rotherham Railway, and in the following year he was appointed locomotive superintendent and resident engineer to the company. He ordered four locomotives, two from Stephensons, of Newcastle, two from Davy Brothers, of Sheffield, and subsequently two more from the Railway Foundry, Leeds, but getting anxious about the delivery, he proceeded to build an engine in a small workshop at Rotherham. This small 2-2-2 engine, known later as the Old Cutler, is reputed to be the first locomotive fitted with spring side buffers, and in it was incorporated the wedge motion for altering the throw of the excentrics, which has already been referred to.

On the completion of the railway, Dodds opened at the Holmes, near Rotherham, a factory for the manufacture of railway material. This factory was one of exceptional interest, for though at the time the site and buildings were bought by Dodds, it was in the hands of a firm of soap and candle makers. It was up till 1815 owned by the once famous firm of Joshua Walker and Co., and the last job done in it was the casting of the great members of the recently demolished Southwark Bridge. It is of interest to note that Walkers were ruined by the peace of 1815, as many of our present companies seem like to be now. For several years Isaac Dodds did nothing but railway work of one kind and another at the Holmes, one of his most notable inventions being the turntable, and in association with William Owen several other valuable improvements in railway machinery were introduced. In 1845 the works were closed and Dodds removed to Glasgow to assist John Stephenson with the construction of the Caledonian and Lancaster and Carlisle Railways. He is credited with the

design of the well-known malleable iron bridge at Beattock summit. Five years later the Holmes Works were re-opened in order to construct the rolling stock and plant for the Santander Railway, for which Dodds, with Lee and Mould, had secured the contract. The resuscitated firm was styled Dodds and Son. An important invention of this period was a method of "steeling" or case-hardening iron for tires, and rails, which was developed by father and son, and described by the latter in a paper read before the Institution of Mechanical Engineers at Manchester in 1857; another was the design of a boiler for burning coal which was characterised by a water-arch. The construction of locomotives for the Santander Railway also went forward, but the serious political difficulties which arose in Spain in 1868 ruined the firm, which was heavily committed, and the works closed never to open again, and with them the career of Isaac Dodds came to an end, though he lived till 1882.

In this brief outline, based wholly on Major Snell's biography, we have endeavoured to sketch the career of a man who, whilst he did much for the progress of engineering, and particularly for the development of railways, has been almost forgotten. We are glad indeed that a biographer has been found, and we congratulate the author on the production of a monograph which, with many excellent features, has but one serious defect—the omission to give the authority for statements. We venture to hope in the interests of precision that the author will take an opportunity, for which we shall be glad to offer him a welcome in our columns, to publish particulars of the sources of the information on which he has relied.

Modern Gasworks Practice. By ALWYNE MEADE. Second edition. 55s. net.

The Distribution of Gas. By WALTER HOLE. Fourth edition. 50s. net.

London: Benn Brothers. 1921.

WE can do no more than give the reader some idea of the contents of these two stout volumes, for a critical review would involve no less than an examination of several score of diverse subjects, and would occupy as many pages of this journal as we have inches to spare. For Mr. Alwyne Meade's book we have nothing but praise. In it he, an expert gas engineer, endeavours to cover the whole field of gasworks practice, and does it as completely as can be expected in a volume of no more than some 800 odd quarto pages liberally illuminated with line drawings and tone blocks! We have been unable to discover a single important question connected with the manufacture of town gas about which he does not give some information. When we add that he has a far more lucid and easy style than is commonly found in text-books, we have said all perhaps that it is necessary to say to assure our readers that here is a book well worth possessing. But let no one suppose that because it is in its second edition it has reached finality, or still less that the present volume is no more than a reprint of the first edition, which appeared only so recently as November, 1916. In the four years that have elapsed "the technique of gasworks methods has undergone nothing less than an upheaval," with the consequence that the volume has had to be almost entirely re-written, and its bulk is twice as great as before. Its predecessor was *the* text-book of gasworks practice. It, itself, now holds that important position, and as long as Mr. Alwyne Meade is prepared to write a new edition every few years, his work is likely to remain unassailable.

Mr. Hole's book, now in its fourth edition, is the natural pendant to Mr. Meade's. With the two before us we have a complete encyclopedia of the town gas industry. The matter with which Mr. Hole deals is an extremely broad one, and we have no right to be disappointed if now and then we search his pages in vain for particular information. To discuss and describe all the appliances that are used for the distribution and consumption of gas would involve the preparation of a library, and each of Mr. Hole's chapters might be expanded into a volume. Hence, he has been obliged to satisfy himself with the description of a few selected examples, and it may well be that in some cases the examples chosen will not, by all readers, be regarded as either typical or the best. That criticism, the author himself must have seen was inevitable. His style is a little on the dry side, and on some occasions he is prone to diffuseness, and on others disappoints us by his brevity. But for these things there is every excuse in the endeavour to compress a bushel of material into a peck measure. We wish, however, that in his desire for thoroughness he had not included a chapter on the gas engine, which is not very good, and is, in view of the abundant literature of that subject, unnecessary.

In conclusion, we may say that this, the fourth, edition of Mr. Hole's book is printed on a larger page than its predecessors, and despite the fact that two entirely new chapters have been added, is not quite so portly. We desire to congratulate Messrs. Benn Brothers, not only on the publication of these two important volumes, but on the admirable manner in which they are produced.

German Disarmament—Effect on Industry.

IT is said of the Washington Conference that the victorious Powers, having disarmed their enemies, are now voluntarily disarming themselves. The effect of this disarmament on German industries will be of particular interest at this juncture, and a brief review of the position may be welcomed by our readers.

The naval clauses of the Peace Treaty can be summarised shortly as follows:—(*a*) Germany may have a navy not exceeding the following number of ships in commission: six pre-war Dreadnoughts, six light cruisers, twelve destroyers and twelve torpedo boats, with no submarines of any type at all; (*b*) these ships may only be replaced after a definite life and the replacing ships must not exceed the tonnage given below:—

	Life. Years.	Displacement. Tons.
Armoured ships	20	10,000
Light cruisers	20	6,000
Destroyers	15	800
Torpedo boats	15	200

(*c*) The *personnel* is to be reduced to 15,000, with not more than 1500 officers; (*d*) all warships under construction at the signing of the Armistice are to be broken up.

The remainder of the German fleet, except for some very old ships, having been surrendered it will be seen that the reduction in that fleet is much more drastic than the proposals of the Washington Conference. In Germany, as in this country, the establishments effected are of three kinds, viz., (*a*) the old Imperial establishments corresponding to our Royal dockyards and arsenals; (*b*) the large armament works and shipyards which specialised in naval and military work; (*c*) smaller works only utilised during the Great War and now engaged in their pre-war occupation.

The main establishments under heading (*a*) include the following—the ex-Imperial dockyards at Wilhelmshaven, Kiel, and Dantzic, the arsenal at Spandau near Berlin, and the torpedo factory at Friedrichsort on Kiel Bay. So far as the dockyards are concerned, Dantzic having been taken away from Germany the yard there is not under its control. It has been decided to leave Wilhelmshaven as a building yard to help in supplying the warships required in the future. It is capable of building the hull and supplying the machinery of a battle cruiser of the "Hindenburg" class. It also has graving docks large enough to accommodate the biggest ship allowed for the post-war fleet. These occupations only utilise a part of this extensive dockyard, and the remainder has been separated and handed over to a company under the control of the German Treasury, which is developing it on commercial lines, it being suited for general engineering work and the building of small steamers, &c.

The ex-Imperial yard at Kiel has also been divided into two parts. One which contains the graving docks and basins will be used as the Baltic Sea base for the post-war fleet, and the remainder, including the building slips, the engineering shops, &c., has been transferred to a department under the Treasury and is being worked as an ordinary shipyard. Work on some 8000-ton steamers has been begun. The department of the Treasury previously mentioned has also taken control of the Friedrichsort torpedo factory and the arsenal at Spandau. In all cases the management has been recruited from the officials previously attached to each place, but their number and status have been altered to agree with the reduced *personnel* and the changed conditions. The number of employees in these various establishments as given in *Schiffbau* have varied as follows:—The oldest dockyard, that at Dantzic, employed about 3500 men before the war and increased its staff to 9000 men in 1918. This yard, as mentioned before, is not now under German control. The Imperial yard at Wilhelmshaven employed 11,000 men in 1914 and this number increased to 23,000 in 1918. The post-war numbers have dropped to 11,000, of which about 4000 are employed in the commercial yard. The employees at the Imperial yard, Kiel numbered 9200 before the war, but a total of 17,000 was reached in 1918. After the Armistice the number was reduced to about 11,800, of which the greater number were absorbed by the commercial part of the yard. The big torpedo factory at Friedrichsort increased its numbers from 3000 to 5500 during the war. When transferred to the Treasury the *personnel* had been reduced to the former figure. These reductions in *personnel* have led to a great reduction in the number of permanent officials. At present they number less than 25 per cent. of the pre-war figures.

It is typical of the existing *régime* that efforts should be made to use the State yards and factories up to the hilt to meet the needs of the future. Control has passed from the military to the civil authorities, and work has been distributed so as to give employment generally. This State enterprise is favoured by the workmen generally, and they resent any suggestion to transfer any of these industrial concerns to private owners. The conditions of labour, hours and wages are standardised throughout the country. There are no doubt political reasons for the adoption of this form of nationalisation. It is notorious that the dockyard towns were centres of unrest, and revolts in them precipitated the asking for the Armistice. By giving employment this spirit will be quietened. On the other hand, the unemployed official class are very discontented and generally have monarchistic tendencies.

The second type of establishment corresponds to our big armament works. The firm of Krupp was the outstanding example. With its steel works at Essen, its shipyard at Kiel and the allied establishments throughout the country, it employed about 200,000 hands during the war. The M.A.N. and A.E.G. groups also employed thousands of men on munitions, and the optical works of Zeiss and Goerz were also on war work entirely. In short, all the big engineering concerns of Germany were engaged on war contracts, and when the Armistice came had to be transformed to a peace production basis.

It has always been the rule to build the great majority of the German fleet in private shipyards, and, in fact, as mentioned previously, only one Imperial yard could build a battle-cruiser, namely Wilhelmshaven. So far as Kiel was concerned it could build smaller battleships and light cruisers. Apart from one battle-cruiser on the slips at the former dockyard and one light cruiser launched from Kiel, the whole of the warships and submarines under construction at the time of the Armistice were being built in private shipyards.

The amount of work in progress was as follows:—Battleships, 3; battle-cruisers, 4; light cruisers, 7; torpedo craft, 114; submarines, 240.

In addition, orders had been placed for two large cruisers and one small cruiser, and over two hundred submarines, but work on them had not been begun.

The effect of the sudden stoppage of work on this big programme was to dislocate the shipbuilding and marine engineering industry. As with the auxiliary vessels which were in hand at smaller yards for the navy, and were also stopped, it represented practically the whole of the work in progress at the time. Labour trouble arose immediately, and the breakdown of the transport arrangements, the shortage of fuel and all raw materials accentuated the difficulties in the yards. A form of communistic control of industry was attempted, and for a period the Workmen's Councils took charge. It was no uncommon thing to see the red flag flying over works. In Hamburg, which had suffered severely from the blockade, the shortage of fuel and food being pronounced, two of the largest shipyards closed down for want of fuel. In actual fact, a portion of the men on the books could have been employed, but the trade unions refused to let them work unless all were paid. The end of the war brought a general slackening of effort and demands of all kinds for improvement in pay and conditions of labour. The street fighting which was prevalent interfered seriously with industry. With the establishment of a stable Government this phase passed and conditions steadily improved. Strikes, except for political purposes, have been very rare, and the output is now nearly up to the pre-war figure. Piecework and overtime, banned at the first flush of the revolution, have gradually been reinstated and are now the general rule.

The same shipyards build both warships and merchantmen, the plant required being practically identical. In fact, most of the large yards under heading (*b*) normally had both types of ships under construction at the same time. Thus the only problem was one of obtaining work. Immediately after the Armistice and up to the signing of the Peace Treaty there was a large volume of reconditioning and refitting work as well as the completing of merchantmen due for surrender to the Allies, which kept the reduced staffs busy. In addition, such yards as were building submarines had to destroy those vessels.

By the time peace was signed the conditions had materially improved. The management could estimate the cost and time on a job fairly closely and the workmen did not insist on so many of the rules which tend to restrict output in this country. Accordingly, of the large volume of work which was released when peace was signed, a considerable portion from neighbouring countries went to German yards. In addition, the warships under construction detailed above had to be broken up, and many men found employment on that work.

It is remarkable that the shipbuilding industry of Germany has profited from causes, most of which are the consequence of that country losing the war; but it must be remembered that the German workman has, apart from the short period of unrest previously mentioned, assisted in every way to put the industry on a stable basis.

When the ordinary engineering works are considered the problem has not been so easily solved. The immense plant installed for the manufacture of guns and shells must await the creation of new demands before it can be employed. As in other countries much of this special machinery cannot be utilised and is lying idle. One or two things have, however, assisted the German firms. At the Armistice the German rolling stock had been greatly depleted by the locomotives, &c., surrendered to the Allies, whilst what remained was in a very bad state.

Travelling in Germany was only done by permit, and was restricted to a minimum. The condition of the rolling-stock may be judged from the fact that the coverings had been removed from first-class carriage cushions, and one sat on the bare canvas. This was in consequence of the stripping of the country of all wool. Leather straps and brass fittings were also removed, and the carriages were just shells. The locomotives were also in a bad state of repair. Accrodingly, one of the first things done was to adapt several engineering shops to enable them to manufacture locomotives and rolling stock generally. A part of this work was given to the shops in the old Imperial dockyards.

The steel industry has also managed to get work to employ the reduced staffs. At one time a crisis of over production was feared, but the shipyards and engineering works have called for more steel than anticipated, and, in addition, shipbuilding in Holland and Scandinavia draws most of its steel material, including castings and forgings, from Germany. There has been also a large amount of railway and structural work carried out in the country, all of which has needed steel.

The great factor now in keeping Germany employed is her depreciated currency. It is interesting to note that the different branches of industry have agreed amongst themselves as to the prices to charge for similar goods. When the exchange improved in June, 1920, and they could not export at a profit the optical firms agreed to stock their productions. Similar safeguards are adopted in other trades.

In conclusion, it may be said that Germany has transferred her industry from a war to a peace basis successfully, but she has been assisted mainly by the fall in the exchange and not a little by the industry and zeal of the workmen themselves.

HYDRO-ELECTRIC SCHEME FOR A SCOTTISH COLLIERY COMPANY.

As briefly mentioned in the letter from our Scottish correspondent last week, the Balgonie Colliery Company, Limited, of Markinch, has almost completed the necessary work in connection with its hydro-electric scheme on the river Leven. The Leven is eminently suitable for water power purposes, and for well over 100 years it has supplied energy to various industrial concerns. The more or less obsolete water wheels originally used have, however, been for the most part replaced by modern turbine plant, and some excellent types of power producing installations may now be seen at work on the river between Leslie and Leven.

The Balgonie Colliery Company has had for some years a small hydro-electric installation near the village of Milton, and the success of that plant has led the company to undertake a larger scheme, which, when completed, will utilise all the available water power within the boundaries of the land belonging to it. The work, which was commenced in April last, would have been completed ere this, but it has been retarded owing to unfavourable weather conditions. The water is conveyed in an open aqueduct over a mile in length and with a depth of from 4ft. to 5ft. Three sluice gates are provided at the point where the water is taken from the Leven, so that in times of flood no more water will be allowed to pass to the power station than is required for the maximum load. The available head of water at the power station is about 40ft. Two bridges have been constructed over the waterway, and elaborate precautions have been taken so as not to interfere with the foundations of the railway viaduct at Sythrum, where the aqueduct passes under it. The water flows from the aqueduct to the power-house through two steel penstocks, the power-house being almost at the same level as the river bed. The turbines are of the high-speed type, and are built to the designs of Messrs. James Gordon and Co., London.

The whole of the constructional work has been carried out by Messrs. John Miller and Co., of Inverkeithing, under the supervision of Mr. W. P. Proudfoot, the colliery company's engineer.

The Re-equipment of a Machine Tool Works.

ALTHOUGH the present condition of trade does not, as it stands, justify the development and extension of works and factories, it is, nevertheless, true that throughout the country there is a considerable, almost a surprising, amount of activity in the way of reorganisation and re-equipment in anticipation of the better times to come. Among those who, viewing the future with confidence, are preparing themselves to take full advantage of the revival of industry as soon as it occurs, is Alfred Herbert, Limited, of Coventry. On the invitation of this firm, we recently visited its works with the object of inspecting the alterations which it has now practically completed in its workshop arrangements. The firm has taken the opportunity afforded by the present slack time, not only to re-equip large sections of its establishment with new machine tools, but completely to rebuild an out-of-date portion of the workshop buildings, namely, that portion which thirty years or so ago formed the original Alfred Herbert works, and round which the existing factory has grown up.

OLD GEAR-CUTTING DEPARTMENT WITH MACHINES REMOVED

NEW MILLING DEPARTMENT, SHOWING FLOOR UNDER CONSTRUCTION

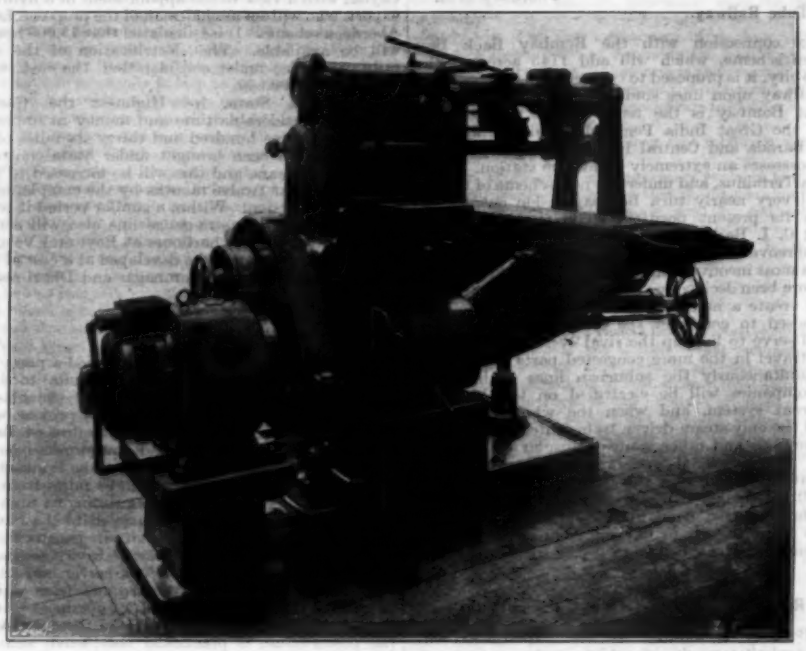
The old part of the works was characterised by the possession of a very low roof with wooden trusses supported on numerous brickwork columns. The machines which it contained—principally gear cutters, thread millers and keyway cutters—were of the countershaft-driven type, and were not in accordance with modern efficiency standards. At the same time, space in other parts of the establishment was cramped, and certain of the machines in use were not of the most modern type. With these circumstances before it, the firm decided to reorganise its works in three main respects. In the first place, the gear-cutting department was to be removed to a separate building erected during the war on an adjacent site for the production of certain munitions. Secondly, the original portion of the existing factory was to be boxed in, pulled down and rebuilt from floor to roof on modern lines for the purpose of housing the milling machine department. Thirdly, throughout the whole works, including the gear cutting and milling departments, the machines previously in use were so far as possible and convenient to be taken out of employment, transferred to the second-hand sales list and replaced by modern single-pulley machines drawn from Messrs. Herbert's own stock. In arriving at these decisions the firm was guided by its strong belief in the economy of milling as a machine shop process, and in the increased efficiency and output obtainable from all classes of machine tools by means of a single-pulley all-geared drive in place of a stepped pulley and countershaft drive.

NEW MILLING DEPARTMENT COMPLETED

Before the work of pulling down the old portion of the factory was begun, the space occupied by it was completedly boxed in with matchboarding, in order that the work of demolition and reconstruction might be carried out without subjecting the adjoining departments to the annoyance of dust and the effects of bad weather. The department as reconstructed consists of two and a-half 30ft. bays, each about 60ft. long. The old brick pillars were replaced by steel columns carrying a saw tooth roof on steel joists. The new roof has thus been raised to the level of the existing roof in the adjoining

departments, but is superior thereto in that the latter has been left as originally formed, with wooden members. The new roof construction is interesting. On the unglazed slopes it is formed outwardly of corrugated iron with sheets of cement asbestos nailed to battens on the underside. In the glazed slopes large top-hinged ventilators are arranged for operation in groups of six by means of a crank handle and worm shaft gear.

The floor of the new department is constructed of a 12in. layer of rough concrete, on which are laid parallel 3in. by 3in. creosoted timbers levelled up with a 3in. layer of fine concrete, the whole being finished with 12in. by 1¼in. plain-edged floor boards

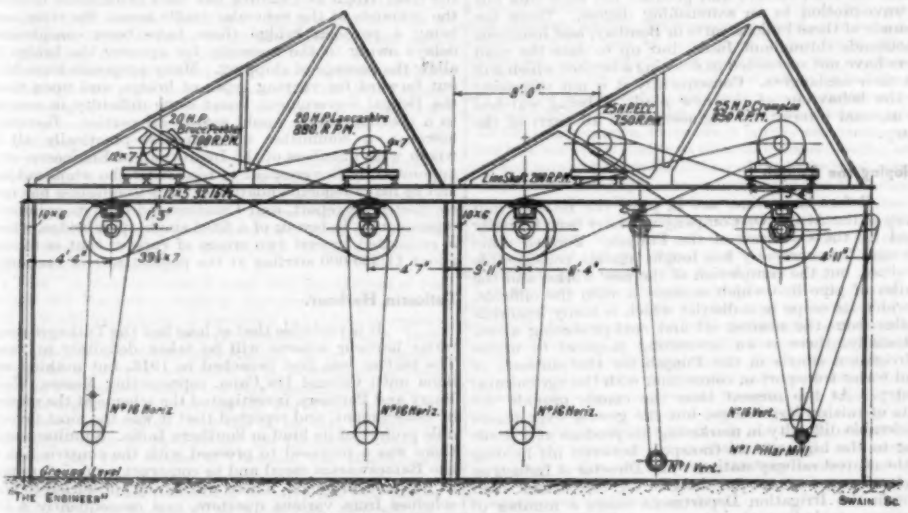


HORIZONTAL PLANE MILLING MACHINE WITH SEPARATE MOTOR DRIVE

fixed at right angles to the main timbers. The lighter machines are allowed to rest directly on the floor boards without attachment of any kind. In the case of the heavier machines, the floor boards are cut away to allow the base to rest directly on the concrete, with grouting applied round the edges of the base. It is perhaps worth recording that in the case of machines—such as a vertical drilling machine—the height of which is considerably greater than the width of the base, the plan of bolting the base down to the floor is found to increase the vibration to a very considerable extent, the machine standard then acting after the manner of a tuning fork.

In the arrangement of the machine drives, special pains have been taken to secure long belts running vertically, or nearly so, in every instance. The line shafts from which the machines are driven directly are mounted in Hoffmann hangers, and are placed as nearly as possible vertically over the machines to be driven. Each line shaft drives a group of machines, and is itself driven by a 20 or 25 horse-power motor mounted on cross girders above the level of and supported on the roof joists. The actual support for the motor consists of two pairs of channel irons fastened by bolts across the tops of two adjacent joists with two pairs of smaller channels similarly fastened across the tops of the first pair. The motor is attached to the smaller set of channels, while

across the larger a platform is arranged to facilitate the inspection of the motor. The electrician, when required, reaches the platform by means of a portable ladder from the shop floor. This arrangement of the motors and belt drives is undoubtedly a very neat and efficient one, and allows practically the full value of the daylight received through the roof to be utilised at the floor level. The only possible objection to it is the situation of the motors overhead, and the difficulty thereby created of arranging an overhead crane to work above the machines. As a matter of fact, the arrangement is discarded in the case of the larger machines into which the size of the work commonly put is such as to require the service of a crane. The alternative adopted is to drive each such machine separately by means of a 15 horse-power motor mounted on a tee-slotted adjusting base, with the drive taken through an enclosed chain running in oil. The control and switchgear is mounted on the machine frame. The drive is so arranged that it is not necessary to stop the motor when it is desired to stop the milling cutter. For this purpose the driven chain wheel is fitted with a friction clutch, so that with the motor running continuously the cutter may be started or stopped at will. It



ARRANGEMENT OF THE MACHINE DRIVES

would, no doubt, save first cost to start and stop the motor, but such a plan, it is held, would waste time and would not economise the consumption of energy.

In reorganising the shops, opportunity has been taken to bring up to date the jig and tool store system, the control of the feeds and speeds of the machines and similar features influencing economical working, but care has been taken to avoid extreme systematisation, for it is recognised that it is quite possible to expend more money on the working of an "efficiency" system than is saved by it in practice. The systematisation of the feeds and speeds, for example, is not carried farther than the preparation of a card bearing the particulars of a job and the feed and speed to be used for each machine operation on it. This card is handed to the workman, and is open to the inspection at any time of those in control. The arrangements for heating the shops have also been modernised. Supplies of hot air are delivered into the shops by means of Sturtevant heaters using steam at 10 lb. pressure. A fan in each unit draws the air downwards from the outside atmosphere, and delivers it in a heated condition at the floor level. The vitiated air finds its way outside, either through the ventilators in the roof of the reconstructed shop or through electrically driven extractor fans in the roof of the older portion.

Institution of Electrical Engineers.

ON Thursday evening, March 2nd, three papers, dealing with electric motor starters, were read at a meeting of the Institution of Electrical Engineers. The first, which was entitled "British Standard Specifications for Motor Starters," was read by Mr. C. H. Wordingham, and is as follows:—

A request for standardisation in connection with motor starters led to the formation by the British Engineering Standards Association in 1914 of a Committee under the chairmanship of the author.

Considerable difference of opinion was found to exist regarding the distinction to be drawn between a motor starter and a motor controller. It was finally agreed that the differentiation should be made on the basis of performance and not on construction, and the following definition of a motor starter was adopted:—

> "The term 'motor starter' denotes a device arranged for starting and accelerating a motor to normal speed, but not adapted for use in positions intermediate between the 'off' position and the 'full-on' position."

The term "starter" includes the following:—

(a) Rheostatic starters:
  (i) Face-plate starters.
  (ii) Drum starters.
  (iii) Multiple-switch starters.
  (iv) Contactor starters.
  (v) Liquid starters.
(b) Auto-transformer (compensator) starters.
(c) Switch starters for induction motors.

The corresponding definition of a motor controller is as follows:—

> "A 'controller' is a device having several steps, contacts or positions, sometimes called notches, used with or without resistances, for regulating the speed of a motor or motors, and may or may not be used for starting. The term 'controller' does not include the resistances or other means of control employed therewith. Simple shunt regulators are not included in this definition.

The present discussion relates only to motor starters, but it will be necessary to keep the distinction in mind. A specification for face-plate rheostatic starters was prepared and issued first. It was found necessary to discriminate between ordinary duty and heavy duty starters, the frequency of starting being the same in both, and the difference being in the starting periods. There was considerable discussion as to the starting periods before these points were settled, and the Committee was greatly helped by Mr. G. H. Roberts, C.B.E., who dealt with the matter by the practical expedient of making trials on starters actually in use and known to behave satisfactorily under conditions of service. Under his control at Woolwich were a large number of face-plate motor starters, and he was good enough to have observations taken and tabulated, the range of sizes of motors tested being from 10 to 50 horse-power on 500-volt circuits. The speeds varied between 600 and 900 revolutions per minute, one or two cases of variable-speed motors having a very wide range of speed being included. The motors in some cases were driving line shafting, in others machine tools, and in all cases the time of starting was less than that proposed for ordinary duty. As a result of this investigation, the objections which had been put forward were withdrawn.

The Committee was very anxious to provide interchangeability of contacts and centres of fixing holes, and many still hope that these features will ultimately become standard, but after careful consideration the makers have not found it possible at the present time to get sufficient agreement among themselves in regard to these points.

Practically all specifications for motor starters prior to the work of the British Engineering Standards Association Committee included statements as to the number of contacts a starting switch should have, as well as the minimum resistance. Careful consideration, however, of the underlying theory of motor starting will show that the limitation of the current peaks, as given in the specification, provides all that is necessary in this respect.

On completion of the specification for face-plate starters, the following specifications were commenced, the Panel Committee responsible for their preparation being under Mr. G. H. Roberts's able chairmanship:—

Drum starters.
Liquid starters.
Switch starters.
Multiple switch starters.
Contactor starters.
Auto-transformer (compensator) starters.

These specifications are still in draft form, and are not yet approved for issue, but proofs are available for all desirous of taking part in this discussion.

When the British standard specification for face-plate starters was first issued it was generally agreed that after use for a year or two this first attempt at a definite standard for the rating of motor starters might need revision. In the preparation of the remaining specifications for motor starters full use is being made of the experience gained in connection with the pioneer specification, and it is intended to revise British standard specification No. 82 to bring it into conformity with the new ones as soon as they have been issued.

Each draft specification is divided into four main parts,

namely, (i) general definitions, (ii) rating, sizes and marking, (iii) design and construction, and (iv) tests.

Mr. Scott Ram was consulted with regard to Home Office requirements, and he pointed out that as the degree of protection necessary for a motor starter to enable it to pass the requirements of the Home Office depended entirely upon the location of electrical apparatus, it was not possible to indicate in a specification whether a starter would or would not comply with the regulations of his Department. In some cases "open type" might be approved, and in others "flame-proof" covers might be necessary. Attention has been drawn to this matter in the specifications.

The provision of an overload release on a standard starter has been made optional. It is recognised in the specification that motor circuits should be protected by independent fuses or overload safety devices, and that means should be provided, independent of the starter handle, for opening the main circuit of the motor.

These specifications are offered as an important contribution towards the advancement of the industry. Only those most closely associated with their preparation can appreciate the very great difficulties which have had to be overcome in order to reach an agreed basis for the rating, a series of standard sizes, and terms to define the many varieties of enclosure. It is anticipated that the use of these specifications for a year or two will bring to light details which can be improved and desirable additions, and it is also hoped that by the time their revision is undertaken, it will be possible to provide for interchangeability in regard to fixings, renewable contacts and connections with cable boxes.

The question of starters is of great importance to many members of the Institution engaged in different branches of the industry, and the British Engineering Standards Association felt that much benefit to all parties concerned would arise from a discussion of the specifications in their draft form before they were issued to the public. On the one hand, members of the Institution would realise the difficulties besetting the Committee in drafting their proposals and would appreciate the reasons which had led to certain decisions being arrived at, and, on the other hand, the Committee would be likely to receive valuable suggestions from manufacturers and users which might enable them to improve the specifications before issue.

The chairman and several members of the Panel charged with the preparation of these specifications are present, and will be glad to elucidate any points that may arise. It would, of course, not be practicable for a meeting such as this to assume the functions of a committee, and to come to a decision on modifications or additions to the several specifications, but all observations, criticisms, and suggestions made—more especially the last named—will be heartily welcomed by the British Engineering Standards Association Panel, and will receive the fullest consideration before the specifications are completed.

In conclusion, I would emphasise the fact that every British Engineering Standard Association specification comes up automatically for consideration and, if necessary, for revision each year. Obviously, a beginning must be made, and while subsequent editions will undoubtedly represent an improvement on the first, it is hoped that those present will recognise the value of this pioneer work and do their utmost to make it as efficient as possible.

One of the other papers presented at the meeting is entitled "Electric Motor Starters," and was read by Mr. J. Anderson, whilst the third paper, which was read by Mr. W. Wilson, is entitled "Some Notes on the Design of Liquid Rheostats." Owing to the length of both these papers, we are unable to do more than summarise their contents. In the former case the paper deals with the practical development of an electric motor starter from the first principles, relating to current torque and resistance values. It describes a method of working in percentages for all calculations; defines what is meant by starting, accelerating and running torques; refers to the lack of data regarding starting conditions; and gives tables of stored energy in rotors for the normal load torque during acceleration and for the stored energy of a number of typical machines.

Accelerations are classified as "natural regular," "natural irregular," "forced regular," and "forced irregular," and typical diagrams with automatic contactor and hand-operated starters are shown.

A formula is given for estimating accelerating times and torques, and the number of notches from the point of view of breaking capacity is considered.

The rating of the resistance elements and points arising out of continuous and intermittent rating, together with diagrams for air cooling, and radiation and diffusion curves for oil-immersed resistances are next dealt with.

Certain difficulties for the salesman in tabulating the horse-power and resistance sizes are referred to, and the necessity of higher standard temperature rises is urged.

Unbalanced rotor currents and the methods of calculating suitable resistance values are dealt with, and the accuracy which can be obtained on test is shown.

Eddy-current, rheostatic stator, auto-transformer and star-delta starters are referred to, and the entirely different type of current and torque curves obtained are shown. Methods of rapidly determining the starter proportions for various duties are given.

Certain points regarding the rating of auto-transformers are raised, and a test showing the effect of unequal tap voltages is given.

Mr. Wilson's paper has for its object the more definite determination of the constants of the liquid rheostat, and the more exact prediction of its performance.

First, the phenomena occurring in such a rheostat under a wide variety of circumstances are considered, a distinction being drawn between the behaviour of direct and of alternating currents in the apparatus. Tests are described which bear out and amplify the conclusions, and many of the tests are characterised by the employment, with impunity, of current densities many times larger than those generally considered to fall within the limits of safety.

Representative designs of rheostats, for both small and large horse-powers, are described and criticised.

A mathematical method is developed for conveniently arriving at the capacity of a given liquid starter, from thermal considerations, which form the deciding factor in this case. A more elaborate calculation, which is capable of more general application, is also given.

Artificial cooling for liquid controllers is dealt with, descriptions of the pipe-cooled and the adjustable weir types being included.

The functions of a liquid slip regulator are analysed, and the usual pattern is reviewed, the conclusion being reached that it could be simplified with considerable advantage.

Finally, suggestions are made with regard to specifications for governing the design and construction of this apparatus.

Indian Engineering Notes.

(From our Correspondent in Bombay.)

February 11th.

Proposed Tube Railway.

In connection with the Bombay Back Bay reclamation scheme, which will add 1145 acres to the area of the city, it is proposed to construct an underground electric railway upon lines similar to the London tubes. At present Bombay is the terminus for two separate systems: the Great India Peninsular Railway and the Bombay, Baroda and Central India Railway. Of these, the first possesses an extremely handsome station, known as Victoria Terminus, and under the new scheme of things, which will very nearly turn Bombay inside out, it will remain in its present position. The terminus of the B. B. and C. I. Railway is, however, a miserable affair, and is, moreover, situated at the southern end of the island in a most inconvenient and un-get-at-able spot. It has therefore been decided to chop off the last three or four miles and create a new terminus, and at the same time it is proposed to construct the new underground lines which will serve to link up the rival systems and also to facilitate travel in the more congested parts of the Fort area. Simultaneously the suburban lines of both the railway companies will be electrified on the 1500-volt direct-current system, and when the whole scheme is completed the only steam-driven trains entering the island will be the mail and other trans-peninsular trains. The length of the suggested underground railway will be approximately 7¼ miles on the twin-tube system, or 15 miles in all. Although the subway will be below sea level, and not far removed from high-water mark at several points, no extraordinary or unusual engineering difficulty is apprehended. The substratum traversed will be chiefly in rock.

Asphaltic Roads.

Bombay is making its first experiment with two-coat asphaltic roads, of which a shining example in London is the Victoria Embankment. For a number of years Bombay's roads have been steadily deteriorating, but for a very long time the Municipality remained impervious to criticism. More recently, however, there was some show of patching things up and now, with the elections approaching, the City Fathers are up and doing! Several different sections of the city will be paved by the Barber method as an experiment, with the object of testing the wearing qualities of the surface under varying conditions of traffic, and of these the first, in the main business thoroughfare in the centre of the Fort, is nearing completion. The one great bugbear of the roads engineer in India is the bullock cart. Drawn by a pair of bullocks, these carts are fitted with large iron-tired wheels of very narrow width—usually from 1¼in. to 2½in.—and when loaded with anything up to 2 tons of goods the wheels cut into the road surface and produce not only ruts but also wave-motion to an astonishing degree. There are thousands of these bullock carts in Bombay, and hundreds of thousands throughout India, but up to date the road makers have not succeeded in devising a surface which will resist their onslaughts. Consequently it is not surprising that the behaviour of the new roads is being watched with unusual interest by engineers from all parts of the country.

Developing the Punjab.

Before these lines are in print the Rawal Pindi refinery of the Attock Oil Company will have been formally opened by the Governor of the Punjab. Formed some years ago, this company has fought against considerable difficulties, but the completion of the new works, and the 45 miles of pipe line which connect it with the oilfields, will widen its scope in a district which is many hundreds of miles from the nearest oil and coal-producing areas. Incidentally, there is an interesting proposal to utilise the irrigation canals in the Punjab for the purposes of inland water transport in connection with the agricultural industry. At the present time the canals provide the means of raising large crops, but the grower experiences considerable difficulty in marketing his produce at a profit owing to the high cost of transport between his holding and the nearest railway station. The Director of Industries therefore proposes to put barges on the canals, and although the Irrigation Department raises a number of objections, including the absence of locks, insufficient headway at bridges and possible damage to banks, the Director of Industries insists that his proposition is feasible. There will possibly be much wordy warfare before a decision is reached regarding existing canals, but it is extremely probable that the Director of Industries will carry his point with regard to new construction, and it may have far-reaching effects in other parts of the country.

The Institution of Engineers.

During the past week the Institution of Engineers (India) has been holding its second annual meetings in Bombay. The headquarters of the Institution are at Calcutta, in which city it was inaugurated by the Viceroy a trifle less than twelve months ago, but the annual meetings are held at different centres. Thus Bombay was the venue this year, and next year it will probably be Madras. Despite the high professional qualifications demanded of members, more than four hundred have been elected since the Institution was legally incorporated eighteen months ago. It is to be regretted, however, that not a few applicants have declined associate membership, but perhaps that is only to be expected in a country in which promotion is more often by seniority than by merit! Subsidiary to the Institution are a number of local associations, including those at Bombay, Calcutta, Madras and in the United Provinces, and others are in course of formation in the Central Provinces and in Mysore State. Incidentally, the President for the ensuing year is Major G. H. Willis, C.I.E., M.V.O., M.I. Mech. E., an officer of the Royal Engineers, who has been intimately connected with the Bombay Mint for more than fourteen years, and has been Master there since 1915.

In Brief.

It is understood that the Secretary of State for the Colonies has been approached by the Government of Ceylon with a view to the appointment of a hydro-electric expert, who will act as chairman of the proposed Laxapanar Aberdeen scheme. It is calculated that 75,000 horse-power will be available. The electrification of the suburban railways is also under consideration, the cost being estimated at £1,000,000.

In Baroda State, his Highness the Gaekwar is devoting considerable time and money to improving the railways. Three hundred and thirty-six miles of narrow-gauge line has been brought under State control within the last few years, and this will be increased to 380 miles within the next twelve months by the completion of lines under construction. Within a similar period it is probable that 300 miles of metre-gauge line also will come under State control. Small harbours at Beyt and Velan, on the Kathiawar coast, are to be developed at a cost of £200,000, and will be linked with Jamnagar and Dhari respectively by new railways.

The Andhra Valley Scheme.

A few days ago I accompanied a party of members of the Institution of Engineers (India) to the largest hydro-electric power station in India, which is nearing completion. This is the Andhra Valley project, which was originated by the well-known Parsee firm of Tatas, who are proprietors of the iron and steel works bearing their name at Jamshedpur. The storage lake is situated at the top of the Western Ghats, about 60 miles from Bombay as the crow flies, and after passing through a tunnel 2 miles in length the water will be conveyed to the power-house at the foot of the hills through six penstocks. At the power-house six Pelton wheels will drive a similar number of generators, and the latter will deliver current at 5000-volts pressure to step-up transformers, from which it will be conveyed across country on an overhead transmission line at 100,000 volts pressure. At the present moment the power-house is practically completed, and an effort is being made to complete at least one penstock before the break of the monsoon in the month of June. This will enable one unit of 10,000 k.V.A. to be placed in service so as partially to relieve the insistent demand for electric current for the cotton mills of Bombay. The whole of the plant, having an output of 60,000 k.V.A., will be completed about twelve months hence, and the designs have been so planned that either one or two additional units can be added at some future date with a minimum of inconvenience. Incidentally, an interesting feature of this project is that current will be delivered to consumers' doors at 20,000 volts and will be converted to 500 volts direct current on the spot.

Howrah Bridge.

For many years past the Howrah Bridge across the river Hugli at Calcutta has been insufficient to meet the demands of the vehicular traffic across the river, and being a pontoon bridge there have been considerable delays owing to the necessity for opening the bridge to allow the passage of shipping. Many proposals have been put forward for varying types of bridge, and upon them the Bengal Government found some difficulty in coming to a decision which would satisfy all parties. Recently, however, a committee of engineers—practically all of whom were members of the Institution of Engineers—was appointed by Government to reconsider the whole subject and to make recommendations. This Committee has now completed its report, and I understand that its opinion is unanimously in favour of a fixed single-span bridge, which is estimated to cost two crores of rupees, that is to say, about £1,350,000 sterling at the present rate of exchange.

Tuticorin Harbour.

It is probable that at long last the Tuticorin deep-water harbour scheme will be taken definitely in hand. The matter was first broached in 1915, but nothing was done until Colonel Du Cane, representing Messrs. Wolfe Barry and Partners, investigated the scheme at the request of Government, and reported that it was the most favourable project of its kind in Southern India. Simultaneously there was a proposal to proceed with the construction of the Rameswaram canal and to construct a miniature port at its landward end. There was strong opposition to both schemes from various quarters, and consequently a few months ago Government appointed a committee to review both projects. This committee has now completed its deliberations, and has reported that it is desirable that the Tuticorin scheme should be proceeded with vigorously, but that the canal project should be shelved for the present.

PROPOSED INSTITUTION OF CHEMICAL ENGINEERS.—The sixth meeting of the Provisional Committee for the Institution of Chemical Engineers was held on Wednesday, March 1st, 1922, at 166, Piccadilly, London, W. After the usual formal business had been transacted, the honorary treasurer reported that the balance to the credit of the proposed organisation was £400 10s., and that the sum of £1232 had been promised and £493 1s. had been paid. The honorary secretary reported that up to date about one hundred gentlemen had expressed their willingness to serve on the Advisory Committee, and names were still coming in. The question of premises was raised by the honorary secretary, and after a considerable amount of discussion the kind offer of Mr. Woolcock was accepted, viz., to provide temporary accommodation at 166, Piccadilly, London, W,. to which all communications should be addressed in future.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

TIMOTHY HACKWORTH AND THE LOCOMOTIVE.

SIR,—No one who has studied the early history of the locomotive can fail to notice that many writers, of whom the principal was, unfortunately, his son, the late J. W. Hackworth, have, in trying to bring the work and character of Timothy Hackworth into relief, thought it necessary to discredit the work of Stephenson and in some cases to blacken his character. Even to-day, after nearly one hundred years, there is so much feeling on the subject that any one who ventures to challenge in the Press some of the statements to which I refer is likely to be the recipient of anonymous postcards; such a case has actually occurred within my own knowledge.

The ghosts of old animosities still walk, and I much regret that I was unable to be present at the reading of Mr. Young's paper to the Newcomen Society, which you printed in your last issue, and to ask him personally to help to lay these ghosts after reconsidering all the evidence which is now available. I will confine my principal criticism to the statements quoted below.

(1) That "Stephenson, unable to secure Hackworth in his own firm, was well aware that he might prove a serious business rival in Newcastle and strongly urged his being appointed engineer to the Stockton and Darlington Railway."

Unless this statement of Stephenson's motives can be proved from original documents it should surely now be dropped. Such behaviour is entirely inconsistent with what is recorded of his character at the time. He is known to have recommended malleable iron rails for the Stockton and Darlington Railway in place of the cast iron rails in which he had a direct pecuniary interest. In reference to this action there is a striking testimony to Stephenson's character in a letter written by Michael Longridge to Edward Pease, now to be seen in the railway collection in the Newcastle Library, and there are other contemporary testimonies to the same effect.

Surely it is sufficient to Hackworth's credit to record that Stephenson, who was no mean judge of the ability of others, was sufficiently convinced of Hackworth's capability to recommend him for the appointment on his merits as an engineer and not on his potentialities as a rival.

(2) Referring to the early operation of the Stockton and Darlington Railway, that "The first two years were a period of anxiety and disappointment, almost of despair. The locomotives failed the company."

The first part of this statement may be admitted; the second part is too sweeping, if not absolutely incorrect. The success of the first engine and "the admirable manner in which it does all and more than all that was expected from it" is recorded in the *Gentleman's Magazine* of December, 1825. It is true that the directors had serious cause to complain of the workmanship of the second engine, and their dissatisfaction with the builders is officially recorded in no uncertain terms. But this is far from saying that the locomotives had "definitely failed the company."

(3) That "Owing to the inefficient condition of the locomotive power the company had all but determined to abandon steam in favour of horses, when Mr. Hackworth proposed to construct an engine suitable for working the traffic."

This was the Royal George, an engine "which marked a new era in locomotive power and definitely asserted the superiority of steam over horse traction."

It is clear from the published observations of independent engineers who visited the Stockton and Darlington Railway that during the years 1826–7 the question of the relative cost of traction by locomotives and horses was under consideration and that opinions at the time were still divided, but the above statement (3) is definitely disproved by official documents.

The Royal George, according to Mr. Young's own statement, was tried in September and began running regular traffic in November, 1827. In the Darlington Library may be seen a printed report of the directors to the shareholders, dated July, 1827, containing the following statement:—

"It may be satisfactory to the general meeting to be informed as a result of the strict scrutiny into the subject that there appears to be a saving of nearly 30 per cent. in favour of haulage performed by locomotive engines when compared with its being done by horses."

It is to be noted that the experiments in question were made months before the Royal George was at work.

Surely it is now time to admit that the statement, first made, it appears, on the authority of J. W. Hackworth alone and now repeated by Mr. R. Young, is not one of fact. Those who wish for further evidence will find it in Tomlinson's "Official History of the North-Eastern Railway."

(4) That "It must be borne in mind that the directors of the Liverpool and Manchester Railway appointed a deputation to report as to the advisability of stationary or locomotive engines for their railway, and this report, published in March, 1829, recommended the use of stationary engines. Robert Stephenson thereupon led a powerful opposition to it, in which he solicited Hackworth's assistance, and it is a very significant fact that to enforce his arguments he produced the Royal George and the work done by that engine. Not one of his own locomotives, not the Experiment at Shildon, not the Lancashire Witch at Bolton, nor the Twin Sisters at Liverpool, but Hackworth's engine."

This statement, based presumably upon the fact that Robert Stephenson wrote to Hackworth on March 17th, 1829, for particulars of the performance of the Royal George, is not only misleading, but positively incorrect. In their published "Reply to the Report of Mr. James Walker to the Directors of the Liverpool and Manchester Railway," Robert Stephenson and Joseph Locke in 1829 make the following comment on Walker's conclusions as to the power of the Darlington engines and on his remarks and calculations based on a performance of the Lancashire Witch on the Bolton and Leigh Railway which he records.

"The Lancashire Witch was the most efficient (engine) Mr. Walker had examined, and deductions from its performance would have approximated nearer to the truth than data drawn from the Darlington engines that have been several years in use working under great disadvantages."

It is impossible within present limits to quote at length the figures given by Stephenson and Locke and their deductions, but it would appear from the figures quoted by Walker himself that the Lancashire Witch was a remarkably efficient engine. So remarkable was its performance that Walker ruled it out as too exceptional to be taken as a basis for his calculations.

Further, in comparing the work done by Hackworth's engine and by the smaller engines on the Stockton and Darlington Railway, it appears from the table given by Walker that the loads hauled were almost in direct proportion to the weight of the engine in each case.

From the figures given it appears that the Royal George was just so much the more powerful as it was heavier. In considering improvements in locomotive design, increase in weight is surely not the only standard. The Lancashire Witch was a much lighter engine than the Royal George, but in some ways it marked a much greater forward step in design; it appears to have led on directly to the Rocket, and in the arrangement of its driving gear was in advance not only of the Royal George, built a year before, but of the Sans Pareil, built a year later.

(5) That the Royal George was "the first instance of a locomotive being carried on bearing springs."

There is now available some direct and indirect evidence to the contrary, but space does not permit reference to it here.

(6) Referring to the Rainhill trials and the failure of the Sans Pareil, that "the cylinders—cast and finished at the factory of Robert Stephenson and Co., Newcastle—were the cause of all the trouble."

Surely this is an unfair statement of the case. There were other reasons sufficient to disqualify the Sans Pareil, such as excess of weight and certain features in the design which did not lend themselves to the approval of the directors. Evidence on these points is available to those who care to look for it, but space will not permit quotation here.

(7) That "The first engine ever sent to Russia was built by him (Hackworth) in 1830."

Can Mr. Young produce documentary evidence to this effect? It has been generally supposed that the first engine for Russia was built by Robert Stephenson and Co. and delivered in September, 1836.

March 6th. J. G. H. WARREN.

RAIL CORRUGATION.

SIR,—For the past two years I have watched the behaviour of tramway rolling stock, and I believe that corrugation, if not started, is helped by brake application, rheostatic braking, magnetic braking, and braking by steel shoes of mechanically applied track brakes; furthermore, the excessive slippage of wheels at starting must cause some slight grinding action on the rail tread, more especially on a greasy rail with sand application.

Mr. Leigh has rightly pointed out the harsh treatment meted out to tramcars, but this should not cause the amount of horizontal play too frequently noticed between the horn slides and axle-boxes. This play is, to me, responsible for the almost constant rising and falling of the brake blocks on the car wheels, locking the wheel momentarily, which, as Mr. Leigh suggests, gives 70 to 100 periodic vibrations for a 2–3in. wave for a car running at 20 miles per hour. Destructive as this action is, it must be considerably worse when sand is applied.

It is generally understood that rheostatic braking is to be used in cases of emergency only. From my observations I gather than this condition is not strictly adhered to. Rheostatic braking, unless skilfully applied, results in an immediate wheel lock, and if the car is fitted with automatic sanders in the electric brake circuit, then the moment the car wheels touch the sand patch the increased coefficient of friction causes the sliding action of the wheels to become a grinding action on the rail tread and a possible flat in wheels.

The results of magnetic brake and steel-shod mechanically operated track brakes may be corrugation. Of this I am not too sure. Certainly at certain definite stops on routes operated by cars fitted with these types of brakes there are rail waves, due in part to these brakes, and very probably due to the additional hand brake application. Whether this is rail corrugation or abrasion of the tread due to the high frictional heat generated by the steel shoes and rail is a matter more for experiment than for conjecture.

The possibility of rail corrugation due to starting effort may interest Mr. Leigh. The best case for observation I can suggest is that of the new bogie cars of the L.C.C. Taking the weight of these cars with seventy-eight passengers' load at 20 tons, I am satisfied that the two 62 horse-power motors on a 600-volt circuit will give excessive slippage during the acceleration period, and that the application of sand will result in a momentary grinding action, causing a depression and subsequent crest, to be magnified and rolled along the tread by subsequent cars.

As Mr. Leigh suggests, the centre of gravity and its relation to wheel base has a good deal to do with the excessive loading wheel load, and indirectly helps the locking of the brake block referred to in an earlier paragraph. As an instance of this the following figures may help:—Four-wheel car on 5ft. 6in. wheel base is 27ft. long and 16ft. 6in. from rail to roof of top cover; bogie car on two 4ft. wheel base maximum traction trucks at 14ft. centres is 34ft. long and 16ft. 6in. from rail to top cover roof, both types of cars being approximately 7ft. 2in. wide.

I do not quite agree that the mechanical side should take the whole responsibility; much can be done by members of this branch of the profession in keeping the axle-boxes and horn slides from wearing to a point where horizontal play becomes marked, thus eliminating momentary brake block lock. The existing tramcar brake gear could, with good effect, be redesigned on railway principles and be replaced as existing gears wear out; and, where finances admitted of it, existing wheel bases could be lengthened by fitting one of the several well-known radial devices so as to obtain 8ft. 6in. axle centres. Where track brakes are necessary the long wooden shoe type used on several hilly systems seems to me to have many marked advantages over the present steel type.

Such changes as these would no doubt be costly to make, but with new cars a radical alteration in design might be worth experiment. The centre of gravity could be reduced by low-floor cars on 27in. wheels, with a motor of 20 to 25 horse-power driving each of the four wheels, as against two large 60 horse-power motors driving 32in. wheels and fitted with wooden shod air-operated track brakes.

Manchester, March 6th. J. AUSTIN BAKER, A.M.I. Mech. E.

HOT AIR FOR COMBUSTION.

SIR,—In your issue of February 17th you publish a letter from Mr. George E. Tansley, in which he makes a comparison between the efficiencies of air heaters and water economisers which is unfavourable to the former.

He states that it is not generally understood that while the heat recovered from the waste gases by a water economiser has an efficiency of 100 per cent., the heat returned to the furnace by an air heater has a thermal efficiency equal to that of the boiler only. By way of example he assumes a boiler with an efficiency of 70 per cent., and states that "for every 100 B.Th.U. put into the air the contents of the boiler would receive 70 only, whereas, on the other hand, for every 100 B.Th.U. put into the water by an economiser 100 B.Th.U. are retained, and therefore in this respect alone the air heater may be termed as being only 70 per cent. efficient, as against 100 per cent. efficient for the water economiser."

That part of the statement which refers to the thermal availability of heat recovered by air economisers is not true, and is based upon a rather common misconception. The efficiency of the boiler before the application of an air heater in no way affects the absorption of the heat recovered from the waste gases. Excluding radiation, which can, of course, be prevented, 100 per cent. of that heat appears in the steam generated.

The losses in a boiler plant may be taken to be as follows:—(1) Sensible heat in the ashes and potential heat in the unburnt fuel present with them; (2) loss of potential heat in unburnt gaseous combustibles which escape to the chimney; (3) radiation; (4) sensible heat in waste gases.

Noting the effect of heating the air, Nos. 1 and 3 may be regarded as constant. No. 2 would be diminished, as the heated air would prevent the combustible gases being cooled below ignition temperature.

No. 4 would also be diminished by the amount of heat taken out of the waste gases and returned to the furnace. All this heat must be absorbed by the contents of the boiler. There is no other path. The chimney losses are decreased, the amount of heat entering the boiler contents is increased, and the efficiency of the plant is correspondingly improved. The efficiency *is* affected by, and does not affect, the absorption of the heat taken from the gases.

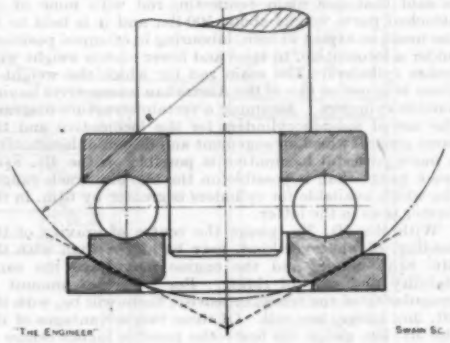
An air heater, therefore, is just as effective in the recovery of heat from the waste gases as a water economiser. Additional and concomitant advantages can be claimed principally in the direction of perfecting the fundamental process of all, combustion; but it is desirable that the error referred to above should be corrected. W. H. OWEN, M. Inst. C.E.

March 6th.

SELF-ALIGNING BALL THRUST BEARINGS.

SIR,—It is with interest that I have read Mr. P. V. Vernon's letter as to the probable sticking of the conical valve seating in the Buxton boiler explosion. I am chiefly interested, however, in the analogy drawn between the ball bearing seating and the valve seating.

While, to a certain extent, such seatings do not respond sensitively to misalignment under load, the amount of sticking is not the same for the conical and spherical types. This will perhaps be better shown by reference to the figure, where conical and spherical seatings are shown. It will usually be found that the surfaces of either the conical or spherical type are almost identical, but a brief examination of the figure will show that, geometrically, while the conical seating means definite relative position between the rings, the self-aligning seating will permit of relative movement. The object of such seatings is, of course, primarily to allow the bearing to take its proper place when initially fitted, and with the spherical



seating, at any rate, response is certain just as soon as unbalanced load conditions, due to misalignment, produce the necessary turning moment.

While appreciating Mr. Vernon's difficulty with such a bearing, we think it possible that some other cause may have been operative to prevent the alignment. Our experience has been that the spherical seatings respond fairly readily, and only a few weeks ago I had ample evidence that movement does actually take place. In the particular machine examined, a rotary movement similar to the action of a ball and socket joint was dependent on the aligning of a seating of this type. The load imposed on the ball bearing was about 75 per cent. of its rated capacity, and the seating when examined had worn evenly all round its surface owing to the movement, as it had been in operation for some time. The difficulty was overcome to some extent by cutting oil grooves in the seating and so obtaining a more sensitive action.

THE SKEFKO BALL BEARING COMPANY, LIMITED,
R. ALLAN, A.M.I. Mech. E.,
Chief Draughtsman.

Luton, March 7th.

THE BUXTON BOILER EXPLOSION.

SIR,—I had forgotten that the valves would be turned round past the bulge when being ground in. But that fact does not exonerate the latter. In the course of gradually descending during successive grindings, the valve would not come hard up against the bulge suddenly, but would at first only just graze it. The man would grind away, thinking he was doing all the work at the seating, but really grinding the wings a little at the same time. The result of this process being repeated over and over again would be that the wings had no clearance to spare at the bulge, and could jam easily, either through differential expansion or a very minute tipping, as suggested by Mr. Vernon.

C. F. DENDY MARSHALL.

Guildford, March 5th.

Unification of Railway Gauges in Australia.

The vexed question of the gauges of Australian railways has again been revived by a recent report of a Royal Commission appointed in February, 1921, by the Governor-General of Australia. The need for a uniform gauge can be appreciated when we observe that the distance between Fremantle on the west and Brisbane on the east is 3488 miles and consists of stretches of 5ft. 3in., 4ft. 8½in., and 3ft. 6in. gauges. From Fremantle to Kalgoorlie there are about 400 miles of 3ft. 6in., from Kalgoorlie to Port Augustus is the east-west transcontinental line, with about 1050 miles of 4ft. 8½in.; from Port Augustus to Terowie, about 120 miles of 3ft. 6in.; from Terowie, through Adelaide and Melbourne to Albury, about 800 miles of 5ft. 3in.; from Albany, through Sydney to Wallangarra, about 900 miles of 4ft. 8½in.; and thence to Brisbane, about 220 miles of 3ft. 6in. Independent of these links, there are minor and branch lines and sidings, and in all Australia, exclusive of Tasmania, there are of 5ft. 3in. gauge 5687 miles main line, 1141 miles of sidings, of 4ft. 8½in. gauge 6727 miles main line and 1063 miles of sidings, and of 3ft. 6in. gauge 11,476 miles main line and 1210 miles of sidings.

The Royal Commission consisted of Mr. J. J. Garvan, of Melbourne, who was not connected with railways; Mr. Rustat Blake, of Sir J. Wolfe Barry, Lyster and Partners; and Mr. F. M. Whyte, an American railway mechanical engineer. The terms of reference were:—(1) Which railway gauge should be adopted in Australia, and the reasons for selection of the one recommended; (2) what is necessary to be done in order to unify the gauges of the railway systems of Australia; (3) what will be the estimated cost of unifying the gauges of (I.) main trunk lines, (II.) all lines, including and showing separately (*a*) alterations to existing railways and structures, (*b*) any new lines necessary, (*c*) adjustments of rolling stock; (4) the order in which the work should be carried out and the methods by which it should be executed and controlled; (5) whether a third rail or any mechanical device should be utilised; if so, what device, upon what sections, and the estimated cost? The report hereon was presented in October last and copies have recently arrived in this country, from which we extract the following:—

The Gauge Recommended.

Only the 5ft. 3in. and the 4ft. 8½in. gauges are sufficiently broad to give the stability and ease of riding to the rolling equipment and ease of maintenance of track, which ought to be available and used in a country of such extended area and great distances as Australia.

With the structure gauges available at present in Australia the 4ft. 8½in. gauge will limit the locomotive capacity less than the 5ft. 3in. gauge. The present practice is to place the locomotive cylinders and as much of the machinery as possible outside the frames and wheels. How desirable this practice is can be appreciated when it is said that one main connecting-rod with none of its attached parts weighs about 500 lb., and it is held to be too much to expect of men, labouring in cramped positions under a locomotive, to raise and lower such a weight with inside cylinders. The main rod for which the weight is given is in use on one of the Australian locomotives having outside cylinders. Assuming a certain structure diagram, the use of outside cylinders for the locomotive and the same general wheel arrangement and design of locomotive, a more powerful locomotive is possible on the 4ft. 8½in. track gauge than is possible on the 5ft. 3in. track gauge; the width available for cylinders is greater by 6½in. in the former than in the latter.

With the 5ft. 3in. gauge the centre of gravity of the loading, of whatever kind, may be higher than with the 4ft. 8½in. gauge, and the engine may have the same stability and ease of riding. For a certain amount of irregularity of the track, crosswise, there will be, with the 5ft. 3in. gauge, less roll. Of these two advantages of the the 5ft. 3in. gauge the first—the possible higher centre of gravity—is not available because of the limits of the structure gauge. The second—smoothness of riding—is a refinement which is difficult to value. The dimensions of the present structure gauge were determined upon in 1905 and considered to be sufficiently large, and not larger than is suitable, for use with the 4ft. 8½in. gauge.

The money cost and the time required to do the work will be less to install the 4ft. 8½in. gauge as standard than to install the 5ft. 3in. gauge. The reason for the great difference in cost is that so many less new axles and new sleepers will be required if the 4ft. 8½in. gauge be adopted than if the 5ft. 3in. gauge be taken; even on the 3ft. 6in. lines there are many sleepers which can be left in place for the 4ft. 8½in. track by adding a few longer sleepers at rail joints and intermediately; whereas for the 5ft. 3in. gauge all would need to be replaced.

Converting the 4ft. 8½in. to 5ft. 3in. means the lengthening of the axles and all the cross members of bogies and cross connecting pieces of locomotive frames. Many of the axles cannot be lengthened because there is not material enough in them to give the required strength if they were drawn out to the increased length. The cross members of bogies and locomotive frames could be cut in two, in a great many instances, and a splicing piece secured in place to produce the additional width between frames. Converting from 5ft. 3in. to 4ft. 8½in. means the shortening of the axles, cross members of bogies, connecting members of locomotive frames, and, in many instances, the narrowing of locomotive fire-boxes. The axles have material enough in them, and it is only a question with wagon, carriage, locomotive tender, and a large number of driving axles, of removing the surplus material, which can be done in one of several methods. The cross members of bogies and locomotive frames will need to be cut in two, brought together and secured. Some of the locomotive spacing castings will need to be replaced. There are in Australia 70,129 axles of 5ft. 3in. gauge and 111,376 of the 4ft. 8½in. gauge. The former figure includes 190 axles of privately owned stock and the latter includes 30,322.

The importance of the sleepers in determining the cost of conversion and the time necessary to do the work will be appreciated when it is known that there are sixty millions in the track in Australia, of which one-half is in the 3ft. 6in. gauge. Sleeper renewals have not been normal for several years, and actually, at present and for some years to come, about five million sleepers will be required per year for maintenance and to make up, within a reasonable time, deferred maintenance. Therefore it is of very great importance to unify the gauges in such a way as to save the greatest number of sleepers now in the track. Seventy-five per cent. of the sleepers in the 3ft. 6in. track are 7ft. long. By adopting the 4ft. 8½in. gauge all the good sleepers 7ft. long and longer can be saved by using four new sleepers, 8ft. long, per rail length—one under each end of the rail and two intermediately. This method is, however, not recommended for the main trunk line nor for any track requiring rails heavier than 60 lb. per yard.

The 4ft. 8½in. gauge is, therefore, recommended for adoption as standard.

The Estimated Cost.

Three schemes are estimated for. The first, known as route A, is the existing lines, with two modifications. The first of the latter is a deviation that will give a direct line from Port Augustus to Adelaide on a more favourable gradient than through Terowie, whilst the second is a deviation between Newcastle and Brisbane, which will reduce the distance between Sydney and Brisbane from 715 to 616 miles, and on which the highest point will be about 800ft. above sea level, as against the present 4400ft. Route B is the same as A, except that a direct line is proposed from Dimboola to Benalla, all in Victoria. The direct line would be 236 miles in length, as compared with about 472 miles *viâ* Melbourne. It would give an almost dead level road instead of having to climb to about 1900ft. above sea level. It will still be necessary to reach a height of about 1800ft. when approaching Melbourne from the west.

The estimated cost of providing a main trunk line of 4ft. 8½in. gauge as per scheme A is £17,850,000, and for scheme B £19,583,000. If to scheme A be added the conversion of all the 5ft. 3in. lines in South Australia and Victoria, the former estimate would be £21,600,000. To convert all the lines in Australia, except those in the island of Tasmania, to 4ft. 8½in. gauge would cost £57,200,000. These estimates provide for rails of not less weight than 80 lb. per yard. The third estimate is for a further modification in Victoria.

The Appointment of a Director.

In order to co-relate properly the work to be done by the Commonwealth and the individual States, to supervise in a general way the work that is done to unify the gauges, and to standardise and check the accounts, there should be appointed a general officer, invested with full control, who, the Royal Commission suggests, should be termed the director. He should be assisted by a civil engineer familiar with track construction and maintenance, a mechanical engineer familiar with designs and construction of rolling stock, and an accountant familiar with railway accounts. There should be used in the new construction work mechanical concrete mixing machines, steam shovels, track laying equipment, and similar devices.

The Chairman's Supplementary Remarks.

Mr. Garvan adds a rider to the report, in which he observes that the Commission, not having been asked for an expression of opinion upon the question whether the railway gauges of Australia should or should not be unified, offers no opinion on that subject. He feels, however, that he, personally, would hardly be fulfilling his whole duty if he did not raise the question whether the advantages arising from the carrying out of the work would warrant the expenditure of the large sum of money involved at the present time, having regard especially to the high cost of borrowing and the equally exceptionally high cost of all constructional work.

The Institution of Electrical Engineers.—The annual conversazione of the Institution of Electrical Engineers will be held at the Natural History Museum, South Kensington, S.W., on Thursday, June 29th, 1922.

Thrust Boring by Manual Operation.

In our issue of April 9th, 1920, we illustrated and described an early form of the Mangnall-Irving thrust boring machine made by the Hydraulic Engineering Co., Limited, of Chester, and a year later—April 22nd, 1921—we gave some details of its application to the boring of nine closely adjacent holes for telephone cables beneath the Channel Sea River at Stratford, London. Thrust boring, it may be recalled, consists of making horizontal holes underground between pits dug at the required distance apart. It is effected by means of a head of special formation which is advanced against one wall of one of the pits by the force derived from a hydraulic cylinder, the reaction of which is taken against the opposite wall. The cylinder is carefully aligned to secure the exit of the head in due course at the proper point in the second pit.

There is no real boring action in the process, for the head does not rotate. The hole is formed by the displacement and compression of the surrounding ground without the production of spoil. The process is thus applicable only to plastic ground, the ideal material being clay. When the head has been advanced to the full extent of the stroke of the hydraulic cylinder, the ram is withdrawn, leaving the head in the bore, and a tubular extension piece is inserted between the end of the ram and the head ready for a second stroke. Additional extension pieces are similarly inserted until the full length of the hole has been pierced, whereupon the head is removed at its point of exit in the second pit and the extension pieces are drawn back into the first and there uncoupled one by one.

Speed, economy, and the small amount of disturbance on the surface of the ground are among the chief advantages claimed for the process. The pits may be anything up to 150ft. apart, longer lengths of hole being bored by forming three or more pits and performing the work in two or more stages. The holes made may be as much as 15in. in diameter, although, in general, large holes are bored by piercing initially a small one and then enlarging it in one or more steps to the final size.

FIG. 1—LAYING WATER SERVICE PIPE

FIG. 2—3½-INCH CABLE DRAWN THROUGH THRUST BORE

The machines previously described or referred to were power-operated, that is to say, they derived their supply of hydraulic energy from pumps driven by a prime mover—a petrol engine of 8 horse-power or so. Recently, however in response to requests for cheaper and more readily portable machines, the company has produced a series of smaller appliances in which the hydraulic power is obtained by means of hand-operated pumps. These machines are primarily intended for short borings under streets, &c., in towns, for the purpose of laying underground electric, water and gas services, and similar small-sized cables or pipes. They are made in several sizes. The smallest requires a pit measuring 4ft. long by 2ft. wide, and has a stroke of 3ft. It is capable of using boring heads 1½in., 2½in., or 3in in diameter, and can bore at a speed of about 60ft. an hour. The maximum nominal range, or length of hole bored by the machine at one sitting, is about 40ft., although in many soils this distance could be exceeded, while in others, such as very difficult "made" ground, it is advisable to keep the range down as much as possible. It should be added that although the new machines are hand-operated, they are so proportioned that the load per square inch on the boring face causing the displacement of the ground is greater than in the power-operated machines previously illustrated, and that as a consequence they are able to bore through most hard made-up grounds which do not contain large stones, concrete or similar obstructions.

For the largest size of hand machine so far made, a pit 6ft. long by 2ft. 3in. wide is required. In this instance the stroke of the ram is 4ft., and the diameter of the heads are 4in., 5in. and 6in. In virgin soil this machine has a nominal range of 150ft. and an overall boring speed of about 30ft. an hour. This machine is of the size and type that is ordinarily driven by an 8 horse-power petrol motor in which case the boring speed would be 300ft. an hour. As operated by hand the boring speed is certainly very slow for the range. The machine, however, has been included in the hand series in order to meet the requirements of a user desiring a machine mainly for street work—in

which case a 2¾in. head would be included in the equipment, and only occasionally for long distance work in which the slow boring speed realised would not be particularly disadvantageous.

In Fig. 1 a photograph is reproduced of a water service lead pipe—to be seen on the footpath at the far side of the road—in process of being laid beneath a tar-macadam road in Rochdale. The ground in this case was composed of dry sand and flints, and the pits were sunk at about 25ft. apart. The machine used is employed both by the water and the electricity departments, and is slightly smaller than the smallest standard design referred to above. It is said to be effecting a saving of between £6 and £10 per boring. It need hardly be remarked that in street work it is very desirable to run the bore so as to avoid any buried pipes or cables. The boring head would certainly break an earthenware pipe if it encountered it. On the other hand, it is not considered likely that an electric cable or metal pipe would be damaged if it were struck.

As another example of the use of the hand-power machines to which reference has been made above, we may mention a case that recently arose in the Hydraulic Engineering Company's own works. It was desired to lay an extra feeder cable from a sub-station at one end of the works to a point near the main entrance, but the only possible route for it ran across ground heavily concreted and laid with setts, and at one point crossed by truck rails. Apart from the expense that would have been involved in excavating this ground it was undesirable to disturb the surface because of the traffic over it. It was therefore decided to thrust bore the work. The operation was successfully accomplished in spite of the fact that the works yard is of considerable age and contains many pipes, brick wall footings and other obstructions that had to be avoided. The nature of the soil bored through varied from clay to water-logged "made" ground. The hole, 5in. in diameter, was thrust bored in three lengths of about 50ft. each, and through it the heavy stiffly armoured 3½in. cable was drawn without difficulty. In Fig. 2, a view is given of the cable as drawn into the last pit. It will be gathered from the condition of the cable that it suffered no damage by being drawn through the bore-hole.

In Fig. 3 we give views of the borer fixed in its pit ready for operation. The appliance has of course to be carefully aligned on the point in the receiving pit at which it is desired the bore shall finish. To this end a target rod is erected on the ground over the mid point of the front edge of the receiving pit. The borer is then slung by wires from two suspension frames placed across the mouth of the first pit, and is roughly aligned on the receiving pit by altering the positions of the suspension frames and adjusting the lengths of the wires. Thereafter the borer is fixed in position by screwing out the backing and front plates against the rear and front faces of the pit. The accurate alignment of the borer on the desired point of exit of the hole is effected by applying two sighting tubes to jigs provided on the hydraulic cylinder and sighting along the tops of these tubes on to a bar placed at a known height on the target rod at the receiving pit. The necessary adjustment horizontally and vertically of the apparatus is affected by the operation of screws connecting the hydraulic cylinder to the carriage extending between the front and back plates.

The actual boring work is begun by advancing a conical pointed pilot bar into the ground for the full length of the stroke of the cylinder. When the hydraulic piston is thereafter run back the pilot bar is left in the ground and on to its projecting rear end is slipped the full sized boring head to be used. This head is cone-shaped and is tapped with internal gas threads on one or more stepped bores in its rear face. The tube screwed into one of the steps is connected at the other end to the hydraulic piston and forms the piston-rod for the next stroke. For each succeeding stroke an additional tube is coupled to the end of the immediately preceding tube and to the piston until first the pilot and then the boring head comes through the wall of the receiving pit. The pilot and boring head being uncoupled, the tubes are drawn back into the first pit. To permit this withdrawal to be done by power, the hydraulic cylinder can be swung vertically upwards through 90 deg. and fitted with a withdrawal ram over which a rope may be led to the end of the last inserted tube. Alternatively, if the object of making the bore-hole is the laying of a steel or iron pipe, the pipe in sections may itself be used as the piston-rod, in which case, of course, the labour of withdrawing the sections from the completed bore-hole is avoided. If a flexible cable or lead pipe has to be drawn through the bore-hole the borer in the vertical position, after having withdrawn the tubes, may be used to pull the cable or pipe through. In such cases it is quite practicable to couple the cable or lead pipe to the end of the first boring tube in the receiving pit and to draw it along the bore simultaneously with the withdrawal of the boring tubes.

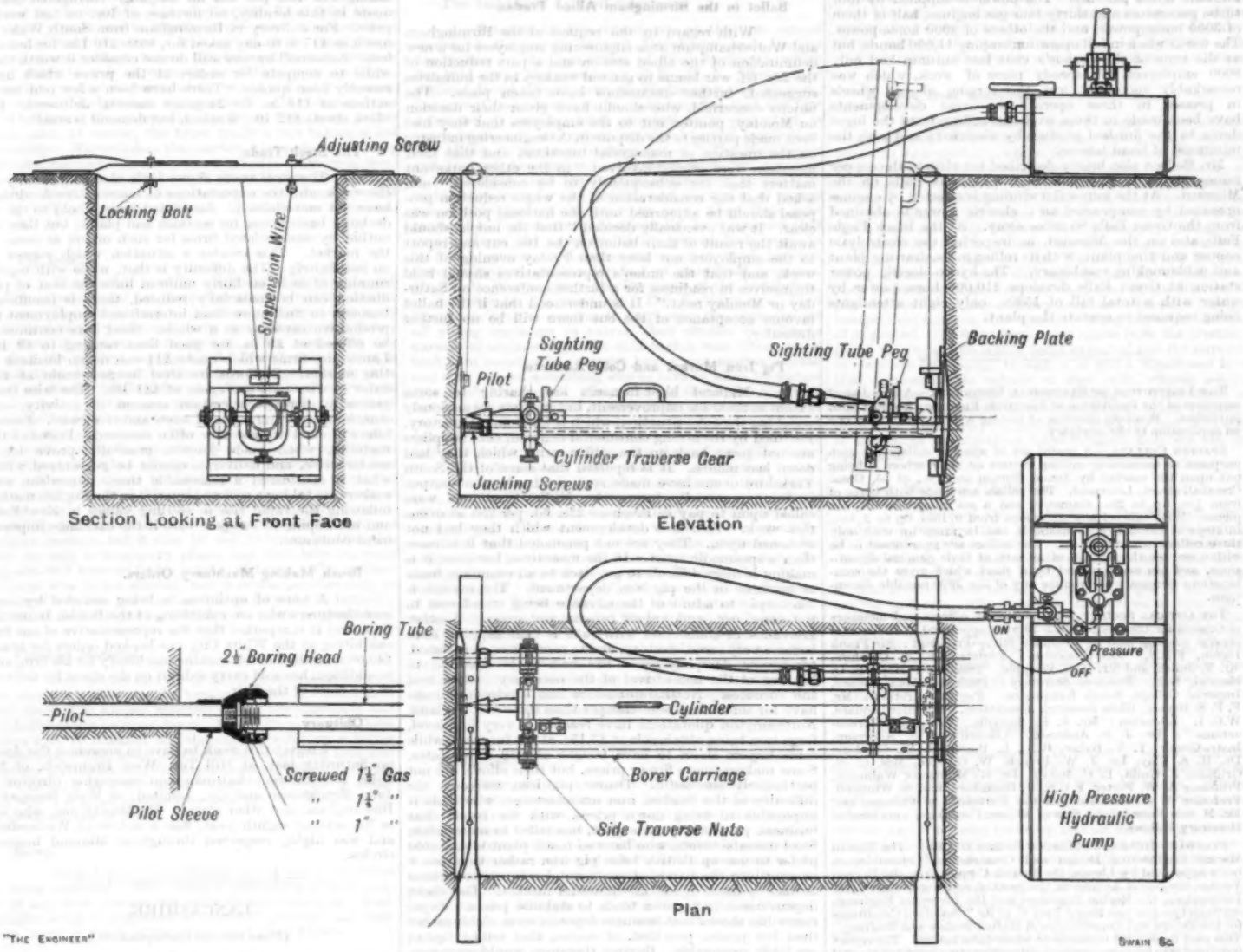


FIG. 3.—PLAN AND ELEVATIONS OF MANGNALL-IRVING THRUST BORER FOR MANUAL OPERATION FIXED IN PIT

American Iron and Steel Production.

IN the course of an address describing a recent business trip to Canada and the United States of America, which was delivered by Mr. J. Phillips Bedson, M. Inst. C.E., to the members of the Engineers' Club, Manchester, the author gave some interesting information respecting the numerous works engaged in iron and steel production which he visited. He said that in 1913 Canadian iron and steel works absorbed about 1 million tons of pig iron, Germany 19 million tons, Great Britain 10 million tons, and the United States of America 30 million tons. The principal works in Canada were the British Empire Steel Corporation—formerly the Dominion Steel Corporation, at Sydney, Cape Breton, Nova Scotia, and the Steel Company of Canada. The former concern had its own ironstone, coal, limestone mines and good shipping facilities. The output of finished material was 40,000 tons per month. The Steel Company of Canada had blast-furnaces and a steel plant at Hamilton, and its output of finished material was 300,000 tons per annum. These two firms produced almost everything in the steel line.

With regard to the United States, Mr. Bedson said that since the war the possible output of pig iron was 50 million tons per annum. At the works of American Steel and Wire Company at Worcester, Mass., and its other plants, 8000 tons of wire of all kinds were produced per week. The company's Donora plant had a wire rod mill capable of producing 800 tons of finished material in 24 hours and a wire drawing mill 950 tons in the same period. This material was used largely in the manufacture of nails, woven and barb fencing. The nail department was capable of an output of 6200 kegs of 100 lb. in each in twenty-four hours. The kegs were made of wooden staves and hoops, and he said that six boys had put together 6700 kegs in eight hours. This company had a zinc plant capable of producing 140 tons in twenty-four hours and made sulphuric acid from the sulphur obtained from the zinc ores. At the Carnegie Steel Works, Duquesne, Mr. Bedson said the blast-furnaces were blown by waste gases. There were thirty-two open hearth 100-ton furnaces and a rolling mill with a productive capacity of 514 tons of 1in. and ¼in. "rounds" in twelve hours. The Jones and Laughlin plant at Pittsburgh and Aliquippa were visited. At the new works at Aliquippa there are two blast furnces, a Bessemer plant and Talbot furnaces, and the finished products included sections, tubes, wire rods and wire fencing. These works are specially well situated for shipping goods down the rivers Ohio and Mississippi to distributing centres. At Youngstown are the works of the Republic Iron and Steel Company, which made a speciality of the production of skelp, tubes, &c., and the Youngstown Sheet and Tube Company was visited. These works have their own blast-furnaces, open-hearth steel plant, rolling mills, rod and wire mill, and drawing and galvanising plant. A special feature of these works is the manufacture of steel for tubes for oil pipe lines, &c.

At Cleveland, Mr. Bedson said, the American Steel and Wire Company's works at Cuyahoga had a most modern plant, including continuous rolling mills. Cold rolling was a speciality. At the Newhaven works, also belonging to the same company, all descriptions of wire drawing were carried out. The company there possessed 2500 fine wire blocks for drawing 33's and 34's wire, and it was capable of producing 35 tons per day. The company has altogether 7500 blocks for fine wire for weaving wire for blinds.

The Detroit Copper and Brass Rolling Mills were among the oldest in the United States. The brass department had been greatly developed. Electricity was used almost exclusively for melting copper and brass, and in

the rolling mills hand labour had been reduced to a minimum. The output was between 180,000 and 200,000 lb. per day. The casting shop is 199ft. long and the manufacturing department 474ft. long by 183ft. wide. There are six 300-kilowatt melting furnaces, each of 2000 lb. capacity. Plates form a feature of the products, and are made up to 138in. wide, and in all thicknesses. Sheets as thin as .001in. are also made. The Ford works were also referred to by the author.

At Chicago, Mr. Bedson inspected the Interstate Iron and Steel Company's works, which are said to have an annual output of 250,000 tons of open hearth alloy and special steels. Great developments, the author explained, had been made in the continuous system of rolling. The chief mill measured 900ft. by 105ft.

The last word in steel works, Mr. Bedson said, was the Gary Company's plant 27 miles from Chicago. It was erected twelve years ago on what was a barren piece of land. The capacity of this establishment was, it was explained, 280,000 ingots per week. The plant comprised twelve blast-furnaces of 550 tons each, forty-two open hearth furnaces of 100 tons each, and three duplex furnaces. The daily coal consumption when in full operation was 12,000 tons, and 800 wagons of 40 tons capacity were handled per day. There were 151 miles of railway track in the works, which were situated on 900 acres of ground. The power consumed amounted to 1,500,000 kilowatt hours per day. The power is supplied by four turbo generators and thirty-four gas engines, half of them of 3000 horse-power, and the others of 2000 horse-power. The works when in full operation employ 11,000 hands, but at the time of the author's visit last autumn had only 8000 employees. A speedy piece of work, which was remarkably successful, was the forging of car wheels in presses in three operations. Great developments have been made in these works in rolling from the ingot down to the finished product by electricity and with the minimum of hand labour.

Mr. Bedson also briefly described his visit to the copper mines at Butte Montana, and the Great Falls on the Missouri. At the mines the winding is effected by engines operated by compressed air; electric power is obtained from the Great Falls 80 miles away. At the Black Eagle Falls, also on the Missouri, he inspected the electrolytic copper and zinc plant, with its rolling mills, drawing plant and cable-making machinery. The hydro-electric power station at Great Falls develops 110,000 horse-power by water with a total fall of 153ft., only eight attendants being required to operate the plant.

The Institution of Electrical Engineers.—A new list of members of the Institution of Electrical Engineers has just been published. Members desirous of having a copy can obtain one on application to the secretary.

Spacing Collars.—A useful set of spacing collars for such purposes as assembling milling cutters on their arbors is being put upon the market by Jones, Burton and Co., of 55, Great Crosshall-street, Liverpool. The collars are made with bores of from ¼in. up to 2in. diameter, and a set comprises fifty-six pieces. With this set any dimension from 0.15in. up to 2.1in., in steps of one-half a thousandth, can be made up with only three collars in combination. The collars are guaranteed to be within one-ten-thousandth of an inch of their nominal dimensions, and are accompanied by a chart which gives the combinations necessary to produce any of the 3900 possible dimensions.

The Optical Society.—The following officers and members of Council for the session 1922–23 were appointed at the annual general meeting held on February 9th:—President: Sir Frank Dyson, F.R.S. Vice-presidents: Professor F. J. Cheshire, Mr. T. Smith, and Mr. R. S. Whipple. Treasurer: Major E. O. Henrici, R.E. Business Secretary: Professor Alan Pollard, Imperial College, South Kensington. Papers Secretary: Mr. F. F. S. Bryson, Glass Research Association, 50, Bedford-square, W.C. 1. Librarian: Mr. J. H. Sutcliffe. Editor of "Transactions": Dr. J. S. Anderson. Council: J. S. Anderson, Instr.-Comdr. T. Y. Baker, R.N., L. Booth, R. W. Cheshire, Dr. R. S. Clay, Dr. J. W. French, W. Gamble, Mrs. C. H. Griffiths, J. Guild, L. C. Martin, Dr. R. Mullineux Walmsley, Professor A. W. Porter, F.R.S., J. Rheinberg, and A. Whitwell. Professor A. A. Michelson, of the University of Chicago, and Dr. M. von Rohr, of the firm of Messrs. Carl Zeiss, were elected Honorary Fellows.

Standard Rules for Marine Boiler Design.—The British Marine Engineering Design and Construction Committee—a body appointed by Lloyds, the British Corporation, the Bureau Veritas, the Naval Architects, the Scottish and North-East Coast Institutions, the Marine Engineers and the Liverpool Engineering Society—has just issued Part V. of its "Standard Conditions for the Design and Construction of Marine Boilers and Shafting.' This part deals with tubulous or water-tube boilers. The report is divided into four sections—all quite short—covering (*a*) general design and materials, (*b*) tubes, (*c*) construction of water-tube boilers, and (*d*) boiler mountings. Among the various rules laid down we notice one requiring that every boiler shall have at least two independent means of feed, each with its own check valve and delivery pipe, and that at least one of these feeds shall be fitted with apparatus for the automatic control of the supply. The feed check valves and also the steam stop valves are to be provided with gear whereby they may be operated from the stokehold floor or other safe position. Superheaters, it is specified, are to be fitted with a safety valve set to blow off at a pressure slightly less than that at which the main boiler safety valves blow off. The majority of the other requirements set forth in the report comprise rules for the dimensions and number of boiler details and for the testing of the materials used.

A Gloucester Firm's Enterprise.—It is gratifying to learn that in spite of the prevailing general depression in trade, Alfred Danks, Limited, of Westgate Ironworks, Gloucester, have found it possible and desirable to effect a considerable development in their workshop arrangements. The firm has in the past carried on the business of engineers and founders and makers of wrought iron pulleys at the Westgate Ironworks, and has operated the Kingsholm Foundry under the title of J. M. Butt and Co. It has now purchased the Emlyn Works, which for many years were operated as an ironfoundry and general engineering establishment by Mr. C. D. Phillips, of Newport, and latterly by the Avon Malleable Ironfoundry, Limited. The works cover about 3½ acres. Messrs. Danks propose to transfer all their work and staff from the Westgate and Kingsholm establishments to the Emlyn Works. The new works are equipped for the manufacture of malleable iron, steel alloy, and non-ferrous castings, and in normal circumstances should find employment for between 600 and 900 men. The equipment includes two cupolas, eight annealing furnaces, four hydraulic moulding machines, five hand ramming moulding machines, three rumblers, a sand blast chamber, various sand mills and mixers, and core and other stoves. In the non-ferrous foundry two Morgan tilting furnaces are installed.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(*From our own Correspondent.*)

The Engineering Situation.

The labour situation in the engineering trades continues the one topic of importance in this part of the kingdom. The threatened stoppage is of serious import to related industries, some of which are showing signs of improvement. If they were thrown out of gear now the result would be most lamentable. It is inconceivable that the growing trade revival will be jeopardised over an issue upon which agreement has already been reached between the leaders on both sides. In the Midlands there is a distinct feeling of hope that matters will not be permitted to come to such a pass, and the brighter news of the past few days has been very welcome, especially to the ironmasters of South Staffordshire, for the engineering branches are considerable consumers of pig iron and bar iron, among other material, and the effect of a stoppage would soon be felt even in the present state of the market.

Ballot in the Birmingham Allied Trades.

With regard to the request of the Birmingham and Wolverhampton area engineering employers for a new delimitation of the allied section and a part reduction of the 26s. 6d. war bonus to general workers in the industries suggested, further discussions have taken place. The unions concerned, who should have given their decision on Monday, pointed out to the employers that they had been made parties to the dispute in the engineering industry on the question of managerial functions, and that their members were deeply involved "in the other important matters that are subsequently to be considered," and asked that the consideration of the wages reduction proposal should be adjourned until the national position was clear. It was eventually decided "that the unions should await the result of their ballot on the 16s. cut and report to the employers not later than Friday evening of this week, and that the union's representatives should hold themselves in readiness for a further conference on Saturday or Monday next." It is understood that if the ballot favours acceptance of the cut there will be no further difficulty.

Pig Iron Market and Coke Advance.

Midland blast-furnaces are sharing to some extent in the trade improvement, but smelters are anxiously watching the coke situation, which is far from satisfactory. Fortified by the strong continental demand, coke suppliers are not going back on the stiffer terms which they laid down last month. It is reported that some of the South Yorkshire ovens have made such good sales that output is being materially increased. Midland smelters were called upon to pay as much as 22s. 6d. per ton at ovens this week. This is a development which they had not reckoned upon. They are not persuaded that it is more than a spasmodic spurt. In the meantime, however, it is making it more difficult to get back to an economic basis of business in the pig iron department. The market is too torpid to admit of the advance being transferred to the consumer, and values remain stationary. Another grievance in connection with coke is that supplies have become very unsatisfactory, and in some cases, it is stated, temporary damping down has had to be resorted to because of the non-arrival of the necessary fuel to feed the furnaces. Northamptonshire and Derbyshire irons have for some time been cheaper than those of Cleveland. Northampton quotations have reached a very low level, forge iron being obtainable at £3 15s. at the furnaces, while some buyers claim to have bought at still lower rates. Some makers quote firmer prices, but their efforts are not particularly successful. Dearer pig iron increases the difficulty of the finished iron manufacturer, who finds it impossible to bring down prices, with the result that business, particularly for export, has failed to materialise. Steel manufacturers, who have so much plant idle, would prefer to use up British basic pig iron rather than see it passing into the hands of continental competitors whom he has to meet in the international market. The slight improvement in pig iron tends to stabilise prices. Experience has shown that business depends upon stable rather than low prices, provided, of course, that selling figures are fairly reasonable. Buying, therefore, would seem now to be a fairly safe policy, and this consideration accounts for the rather better undertone. Some thousands of tons of pigs accumulated at Midland furnaces have been got rid of during the last few weeks. As some of this was made as far back as August last it has invariably been sold at a loss, but the seller is glad to get rid of it. A furnace about to be put into commission in North Staffordshire is understood to have for its object the supply of basic pig iron to an allied firm in South Wales which specialises in sheet manufacture.

Manufactured Iron Trade.

Values in the Staffordshire manufactured iron trade show no quotable change, and the general position of the industry has not altered during the week. The eight hours system is still a serious grievance with the finished ironmaster, who describes it as quite unsuitable for iron production, particularly with the present small output, which adds to the burden of his overhead charges. It was stated during the week that some Indian contracts for bar iron and similar small sizes of a desirable nature are shortly to be placed. Unfortunately the orders, as a rule, are for such small lots that mill rolls have to be changed several times in the course of a shift—a serious hindrance to profitable production. Staffordshire bar ironmasters continue to take an unsatisfactory view of the position, many of their quotations being unacceptable to customers. Several leading Crown bar iron firms of the district have accepted orders at £11 10s., although the nominal quotation continues to be at £12. The basis for marked bars is upheld at £14 10s. Cutting still continues, however, in the unmarked bar branch. Nut and bolt makers do not figure any more prominently in the market, but there has been during the week an improved demand for common bar iron from the fencing trade. The price of British iron has now reached a sufficiently low level to warrant fencing makers utilising it in place of steel, which has for long been preferred by reason of its cheapness. Iron bars for this purpose can now be bought at £10 15s. They have to meet the competition of Belgian bars, which continue to be offered at £9 10s. delivered in this district. The tube trade is not particularly brisk, and the price of £12 10s. for iron strip is not sufficiently low to induce makers to use that material in place of steel, which can be bought for £10 5s. The re-rolling of steel is hardly possible, the Staffordshire re-roller requiring £10 10s. to produce profitably on the finishing of billets bought at £3 less. He finds himself undersold by at least £1 per ton by the large steel works producing from the raw material.

Higher Prices for Galvanised Sheets.

The galvanised sheet trade is showing some improvement, enabling the makers to quote higher prices. Inquiries received this week in Birmingham are rather encouraging, involving in some cases exceptional tonnages. The sheet makers are putting up their prices, in view of the unprofitable character of recent business, some makers asking £16 10s. per ton for 24-gauge corrugated sheets made in this locality, an increase of 10s. on last week's price. For delivery in Birmingham from South Wales as much as £17 is to-day asked for, with £16 15s. for heavier lots. Some mill owners still do not consider it worth their while to compete for orders at the prices which have recently been quoted. There have been a few odd transactions at £16 5s. for 24-gauge material delivered. For black sheets £12 10s. is asked, but demand is small.

The Steel Trade.

The steel trade shows little change generally on the week, and the expectations of more active conditions have not materialised. Associated houses hold to the re-declared basis prices for sections and plates, but they are outbid by unassociated firms for such orders as come on the market. This creates a situation which cannot go on indefinitely. The difficulty is that, while with regular running of mills on fairly uniform lines the cost of production can be materially reduced, there is insufficient business to find more than intermittent employment for productive capacity as a whole. Steel bars continue to be offered at £9 5s. for good lines ranging to £9 10s. Lancashire firms which quote £11 can do no business on this market. Staffordshire steel hoops remain at £12. Sales of wire rods are made at £11 10s. The wire trade generally displays a certain amount of activity, substantial sales being made of screw and rivet wire. Foreign offers of steel are not now often received. Prices of this material, when made known, generally prove to be unattractive, and deliveries cannot be guaranteed within what is considered a reasonable time. American steel makers are taking a renewed interest in the English market, following the rapid rise in sterling values in New York, and are hoping to compete here if the exchange improvement continues.

Brush Making Machinery Orders.

A note of optimism is being sounded by some manufacturers who are exhibiting at the British Industries Fair, and it is reported that the representative of one firm exhibiting at the White City has booked orders for nearly £40,000 worth of brush-making machinery for his firm, and, in addition, has sold every exhibit on the stand for delivery at the close of the Fair.

Obituary.

I regret this week to have to announce the death on Saturday last, at Hill Top, West Bromwich, of Mr. John Brockhouse, chairman and managing director of John Brockhouse and Co., Limited, of West Bromwich, Birmingham, and other places. Mr. Brockhouse, who was in his seventy-eighth year, was a native of Wednesbury and was highly respected throughout Midland business circles.

LANCASHIRE.

(*From our own Correspondents.*)

Manchester, Thursday.

Iron, Steel, and Metals.

One finds considerable difficulty here in believing that any real improvement is to be found in the state of trade. In the Manchester market certainly rather less general business is now being done, and the demand, both for ferrous and non-ferrous metals and manufactured material, seems to be decreasing. Of course, allowance has to be made for the threatened stoppages in shipbuilding and in the engineering industry. The former only affects Manchester indirectly, but if the latter is to be closed down while masters and men are quarrelling about the control of the shops, it is possible that sellers of iron and metals in Lancashire will have a very dull time.

Metals.

There has been a slight recovery in the metal market so far as the prices are concerned, but not the slightest recovery here in the demand. Perhaps the Manchester merchant trade is not in the best position for judging the chances of the metal market, but it is perhaps worth while to note that merchants here still take a pessimistic view, and are inclined to believe that, low as present prices are, they will be lower yet before the real upward turn occurs. One quotes this view of things, of course, without implying any conviction; and it is well to remember that it may be coloured by the local depression, and, of course, the reader must remember that the metal market does not depend upon the state of trade in Lancashire. With regard to copper, the position

seems to be that a larger output will arrive before the consuming markets are ready for it. Whether this will lead to any forced selling, or whether producers will be contented to pile up stocks of refined copper and wait for the market, remains to be seen. One does not imagine that any reasonable reduction in the selling prices would increase the consumption to any serious extent just yet; although no doubt low prices are a needful preliminary to a large consumption. As with a great many articles, the gap between raw copper and its many manufactured forms is far too wide; and this is only another way of saying that the general costs of manufacture—or, in the alternative, the general profits of manufacturers—are higher than the trade of the world will bear. A rather ominous feature of the market just now is the slacking off of the demand from Germany. As our readers know, the share taken last year by Germany of the copper exports from America was very much larger than usual, and so far the prospects are that this share will revert to its old position. The market for tin reacted to a slight extent, but again that reaction does not seem to be caused by any increase in the consumptive demand; at any rate, in this country. The Welsh tin-plate industry is not buying very actively, and at some of the works there is talk of closing should the selling prices become more unprofitable. The shipments from the East during February were below the anticipations, and this perhaps checked the fall which had set in; but there is abundant metal in the market, and whether the East ships less in February and more in March, or *vice versâ*, does not seem to be of much moment. It is not as if the supply were likely to run short before the later shipments arrived. One fears that it is with tin as with copper and iron, that the productive power of the world is greatly in excess of the world's present requirements. The demand for spelter from the galvanising industry has been rather poor, and, of course, the brass trade is not taking a full quantity. Nevertheless the market keeps steady, simply because the metal is not pressed for sale. America, however, may begin to sell here if the exchange rises a little more. Lead is in a waiting condition, but there does not seem yet to be any confidence in the future course of prices.

Pig Iron.

The market here for all kinds of pig iron is dull in the extreme, and yet the prices are, if anything, rather firmer. There is indeed a question whether rather more will have to be paid for foundry iron, at any rate before the next downward move arrives. One reason for this is that the present supply to the Manchester district is small, there being no Cleveland iron at a practicable price and no North Staffordshire or North Lincolnshire iron at any price. Of course, the time will come when these irons will again compete in Manchester, but there is no sign of this at present. The demand for engineers' castings is affected by the uncertainty as to the present dispute, and this perhaps has affected the business in foundry iron here. The quotations for Derbyshire No. 3 pig remain as they were, viz., from 92s. 6d. to 95s. per ton delivered in Manchester. Apparently the demand for export is maintained by the high prices now required by the French and Belgian makers, but it may be well to recognise that this may be only a temporary phase, and that later on more pig iron will have to find a market at home. The position in forge iron is not altered, and it seems possible only to obtain about 75s. per ton for this quality at the furnaces. Of course, the output is restricted as much as possible.

Finished Material.

One cannot find much doing here in finished iron and steel, but this may be because orders are being held back until it is known whether or not the engineers and shipbuilders are to close down. If not, then some of these orders may be released and the market will have a better appearance. The local prices for manufactured iron and steel are unaltered, and the export orders, when taken, are still executed at much lower rates. This is not a situation which is at all satisfactory, and prices will have to be adjusted sooner or later.

Scrap.

There has been no change yet in the local prices for scrap material. Steel scrap is perhaps a little firmer, or, at any rate, dealers are more hopeful about it. Best wrought scrap is neglected at about £3 per ton, and cast scrap is not in much better demand at £4 to £4 10s.

Lancashire's Troubles Increase.

The prospect of a stoppage in the engineering industry unless the workers accept the employers' terms with regard to "managerial functions," coupled with the recent announcement of another general increase of the import duties by India on cotton goods, has tended to increase the general depression in industrial circles. With regard to the former, there are no signs of any weakening in the attitude which the employers have adopted. All the talk about conditions of overtime working seem peculiarly inopportune at a time like the present when most engineering works are on short time, and very short at that; but the question has to be dealt with. In the agreement made last November, which was rejected on a ballot, the men renounced any claim to consultation on this point, and if they are at all concerned about restoring trade to its former position, they will support their leaders in the present dispute. I have never found employers in this district or any other at all anxious to encourage overtime working when it was not absolutely necessary, because under ordinary conditions it is not a paying proposition. It seems to be absurd on the part of the trade unions to contend that if the masters have the right to order overtime to be worked without consulting the men, they are avoiding the agreement with regard to the forty-seven hours working week.

The Cotton Trade.

The raising of the already obnoxious import duties on cotton goods by the Indian Government cannot fail to have an evil effect on the Lancashire cotton industry, which is already suffering from a long period of unprecedented depression, especially in the Indian market, which normally absorbs about one-tenth of the total exports of Great Britain in all kinds of goods. Under the present conditions, protest seems to be of no avail, for India can now dictate its own fiscal policy, which in this case means protection for the millowners in Bombay. Given anything like a return to normal world's trading conditions, however, the matter is perhaps not quite so serious as it would seem at the first glance, for to supply the whole of the Indian population of more than 300 millions there are now about 7,000,000 spindles, or a few more than one-half of the spindles employed in this country to supply the needs of some 40 millions. The Indian millowners have to face a much higher initial outlay than has been the case at home, and in common with all other parts of the world, wages are increasing and the working hours decreasing in India. The weekly working hours in Indian mills have recently been reduced from seventy to sixty-two, and, of course, the Indian operatives are nothing like as efficient as those in Lancashire mills. Nevertheless, Free Trade Lancashire millowners are very sore that one of the partners in the British Empire should adopt a policy of protection against the Mother Country.

The Institution of Civil Engineers.

Judging by the attendance at the first annual dinner of the newly formed Manchester and District Association of the Institution of Civil Engineers, which was held under the presidency of Mr. H. N. Allott at the Midland Hotel, Manchester, on Wednesday, the 1st inst., the parent body ought to be quite satisfied that the new departure of forming local associations is one which is appreciated, and will prove beneficial to the Institution. Mr. Allott, in response to the toast of "The Manchester and District Association," said there were 200 members of this branch, and the average attendance at the fortnightly meetings for the reading and discussion of papers was double that of the previous year, when they were confined to "students." Incidentally, he mentioned that two-thirds of the members of the parent body were to be found outside the London area—a fact which justified decentralisation, or the forming of provincial branches. Mr. W. B. Worthington, the President of the Institution, in replying to the toast of "The Institution of Civil Engineers," took occasion to emphasise the necessity for all young engineers to extend their studies to subjects outside of engineering. He said that a man whose work took him constantly amongst bricks and mortar, smoke and steel needed something else to turn to when he wished "to wash his brain." He said that there was no great demand for the services of civil engineers at present, and regretted that there was much difficulty in inducing young engineers to fill appointments abroad. He said that they ought to take more risks to prove themselves. The toast of "The Manchester and District Association" was proposed by the newly appointed secretary of the Institution, Mr. H. H. Jeffcott, who referred to the sympathetic attitude which his Council adopted towards the provincial associations. These, he said, would prove specially beneficial to the younger members of the profession. He extended to the student members a hearty welcome to the headquarters whenever they were in London. In replying to the toast of "Our Guests," Alderman Walker, chairman of the North-Western Section of the Institution of Electrical Engineers, commended the action of the Institution of Civil Engineers in following the example of his own Institution in forming provincial branches. He said that the "Civils" could not be considered either a revolutionary or communistic body, and facetiously compared the headquarters in London to a holy temple, on entering which he felt constrained to take off his boots.

BARROW-IN-FURNESS, Thursday.

Hematites.

There is quietness still in the hematite pig iron trade, for the demand remains within a limited range, and there is no desire to go beyond immediate wants in placing orders. Even with the recent additions, there are only nine furnaces in blast, although there is prospect of a somewhat busier state of affairs in the near future. In normal times there are twenty-four to thirty furnaces producing iron, out of close upon fifty in existence between Carnforth and Maryport. Before the normal is reached, however, there will have to be more confidence all round.

Iron Ore.

There is only a limited amount of activity at the iron ore mines, the tonnage raised being really small in face of the limited demand, which at present is confined to local users.

Steel.

There is a fair amount of activity in West Cumberland in the rolling of rails, &c., but at Barrow it was necessary last week to close down the main works, owing to the fact that repairs could not be carried out to the Siemens furnaces, the bricklayers being on strike against being included any longer in the sliding scale. The output of rails at Barrow, therefore, ceased. The hoop departments continue to be employed. Steel generally is in small demand.

SHEFFIELD.

(From our own Correspondent.)

Still Waiting.

GENERALLY speaking, the outlook in the steel and engineering trades in this district is very little changed from that of recent weeks, and indeed that of many months past. The best that can be said is that "things are no worse"—the almost invariable reply one gets to an inquiry as to the tendency of trade. Certainly no big orders are being booked, and Sheffield's customers seem to be still waiting to see if prices will come any lower. Indeed, price is not the only factor in some cases. The Yorkshire Engine Company, for instance, which, it may be remembered, recently completed one of the largest locomotives on record for a foreign Government, has this week issued its annual report, in which the directors lament the difficulty of securing fresh orders to take the place of those completed during the past year. Steel makers generally say there is no demand for their products, though it must be pointed out that there is undoubtedly a little more pig iron coming into this district, and that fact cannot be dismissed as void of significance, for pig iron is not a commodity that is hoarded for exhibition purposes or to satisfy the personal idiosyncrasy of a collector with unusual taste. Coal merchants and collieries also report a slightly improved demand, and here again industrial fuels are not bought until there is some prospect of profitably employing them. Then again, coke ovens have in some cases been put on fuller time, and this can only be to meet a bigger inland as well as export demand. These indications, therefore, somewhat discount the unrelieved stories of hardship and impending bankruptcy told by the steel makers and engineers, though, as stated above, it is undoubtedly true that the new business being dealt with is negligible when compared with the enormous resources of the district. It must, of course, be remembered that these resources have been multiplied several times as compared with pre-war conditions, so that a volume of trade that would then have kept the city and district fairly busy cannot now suffice materially to lessen the total number of unemployed locally, which still remains in the neighbourhood of 50,000—one of the largest in the country in proportion to population.

A Lead from Lincolnshire.

Sheffield pessimists may perhaps derive a little encouragement from the somewhat less gloomy outlook taken in Lincolnshire, where the ironmasters are talking of starting up additional blast-furnaces. Speaking at Frodingham the other day, Mr. W. J. Brooke, general manager of the Normanby Park Iron and Steel Works, confessed that he no longer took the pessimistic view he did a year ago. He believes that industry is taking the turn, and said that in a short time he proposed to start up a third blast-furnace at the Normanby Park Works. Although the steel trade still lagged a bit, Mr. Brooke said that he took comfort from the fact that in the matter of pig iron and steel this country had now overcome foreign competition and pig iron was now being exported instead of imported. Confirmation of this comes from the Humber ports, where pig iron is now being exported and the imports of steel are decreasing, though it is still a significant fact that a considerable volume of steel rails, wheels, joists, and castings is coming in from Belgium. That there is still room for very much more improvement in the Lincolnshire iron trade may be gathered from the fact that out of a total of twenty-three blast-furnaces only six are in operation.

Raw Materials "Sold Out."

In spite of the inactivity in the Sheffield steel trade it is reported that there has been so much buying of hematite pig iron and certain other raw materials of the steel industry that producers have sold out their stocks; no doubt recent low prices have been the cause of this, steel makers having bought in hopes of an early revival in trade. The result is that prices of this commodity have advanced by 5s. and 7s. 6d. per ton; the current prices for East Coast mixed numbers is £5 7s. 6d. and for West Coast £5 10s. The only direction in which any increased demand is to be noted is for steel scrap, but holders are not disposed to sell until a better price can be realised.

"Rustless" Still Wanted.

The one department in which it seems difficult for Sheffield to keep pace with demand is in connection with the supply of rustless steel, iron and alloys. While rustless steel is preferred where price is not a serious consideration, rustless iron is proving a formidable competitor, and it is being made up into an increasing number of articles. But rustless iron is still very costly when compared with the ordinary varieties, and metallurgists are busy trying to find ways of cheapening its production. Meantime the makers of the new non-ferrous alloy which has non-staining properties are getting all the orders they can conveniently cope with at present. So far its applications have been confined to table and kitchen ware, and the somewhat extravagant claims which have been advanced for its utility have not yet been realised. The alloy is too soft to have the cutting properties and durability demanded for certain of the applications which have been suggested for it in the lay Press, and there is quite sufficient scope in the domestic sphere for all that the makers can at present make, without embarking on the dubious field of engineering requirements, for which a much harder metal is requisite. These discoveries of "rustless" materials have, however, proved a very timely help to Sheffield manufacturers.

Electric Furnace or "Coke Hole"?

Sheffield Association of Metallurgists and Metallurgical Chemists has been debating the question whether steel can be produced in the electric furnace by refining scrap of a quality as good as that which has been made in Sheffield for well over a hundred years from pure Swedish raw material by means of the old "coke hole" system. Mr. H. L. Lockley introduced the question in a paper on "Swedish Iron and Steel Manufactures." He described the extreme care that is taken with regard to the calcining, mixing and blending of the ores and in the smelting and refining processes in the Swedish charcoal blast-furnaces. Often as many as from eight to fourteen different ores will go into the furnace for a special Bessemer pig iron. The Swedish ores are, of course, noted for the purity and high quality, and for over a hundred years the high-class irons of Sweden have been melted in Sheffield coke holes to make the crucible cast steel for which Sheffield is famous all over the world. The claims of the electric furnace builders to equal this class of steel with common steel scrap were critically examined, and it was found that the

consensus of local opinion is opposed to this view, it being held that the higher the quality of the raw materials used the higher the quality of the steel produced. Sweden, notwithstanding its vast resources of cheap hydro-electric power, has not developed the use of the electric furnace to anything like the degree that might have been expected. Swedish engineers maintain that the electric furnace does not give a product superior to other methods. Regarding the results obtained by electric smelting of iron ores, the officials at Domnarfvet, the largest and most up-to-date iron and steel works in Sweden, state that "Only in exceptional circumstances, i.e., high price of fuel and cheap electric power, can the electric smelting of iron ores become a serious rival to the blast-furnace method of smelting. It is true that metallurgical practice is being constantly improved, nevertheless it is difficult to see how any circumstances can arise which will make electric power sufficiently cheap generally to permit of electric smelting superseding modern blast-furnace methods, which are the result of long and world-wide experience."

A University Demonstration.

During the present week Sheffield University Applied Science Department has been giving demonstrations of the comparative merits of the various types of furnaces, having in view the special needs of the lighter trades. The furnaces shown consisted of coke muffles and an electric hardening furnace. The makers of the electric furnace put forward a very strong case, emphasising, among other things, the value of the magnetic indicator, which automatically records the correct temperature of the steel for quenching. This advantage, coupled with cheapness of fuel, minimum of scale and distortion, improved quality of work, were put before the manufacturers and workmen who attended the demonstration in considerable number. Coke muffles, of course, had their advocates, economy in operating being indisputable. Many cutlery makers brought their blades and other articles for experimental demonstrations with the furnaces. The Sheffield Cutlery Trade Technical Society took advantage of the opportunity and the invitation of the University authorities to hold an exhibition of foreign scissors and razors, and, as was the case with the previous exhibition, there was much to be learned in respect to both quality and price from the foreign samples. An expert, discussing these specimens, remarked to me: "It is perfectly true that a lot of this stuff is not equal to Sheffield products, but if there is a big market for it, it is worth considering, especially now, when we have so many people walking the streets with nothing to do. It is quite certain that the stuff could not be made at the price with our present works equipment. Surely it must be worth while putting in equipment that would enable us to make it." A Sheffield manufacturer admitted that during the past twenty years there had been a marked improvement in the quality of German products; his explanation was that the German workman took more interest in his trade than the Sheffield man did. With few exceptions Sheffield had, he added, gone backward in the same period. Germany had found that there was a market for something between the highest class of Sheffield goods and the old German rubbish; the German manufacturers had introduced machine production and had got a firm hold on this market for medium-grade goods. The manufacturer instanced cast metal scissors, which, as he said, many people would class as rubbish. But they could not fairly be so described if they did the work they were made for, at the price asked. These were marked 3s. 9d. per dozen pre-war price. There was a class of people, he said, who could not afford to pay more than sixpence for a pair of scissors, and the Germans had catered for them; the demand was colossal, and it would pay Sheffield to cater for it. American-made shears with what are known as "lined" blades provided, he continued, another object lesson for Sheffield. The edge was of the best cast steel and the major portion of the blade was of a very mild steel drop forging, welded on. The lining principle was not adopted in Sheffield, but there was ample scope for development in that direction. Another innovation which was inspected with interest was a pair of machine-made scissors, produced at the University as an object lesson for the trade, and now shown for the first time. The article presents many novel features, including interchangeable and adjustable joints. Two pairs had been tested in a large dress-making department in the city, cutting up winter material, and had proved quite satisfactory. As a result of the machine grinding and other methods adopted these scissors could be produced much more cheaply than by the ordinary process. Some very creditable specimens of German razors were also exhibited; the prices, as compared with those of Sheffield products, can only be described as "staggering." If the men worked at pre-war wages and the material was obtained for nothing and manufacturers took no profit they could not compete with such figures. A typical example was a razor bought last month at a price equivalent to 13s. 1½d. per dozen. In Sheffield the blade and the grinding would cost that amount, without allowing anything for the handle, setting or whetting. Most of the German razors have vulcanite handles, and seeing that Germany has to import her rubber and pay about fifty times as much for it as Sheffield has, the fact that she can sell her products as cheaply as she does becomes even more remarkable. The exhibition was continued for three days, and at the conclusion there was an interesting discussion on the lessons to be drawn from it.

Million Pounds for Miners' Welfare.

The Midland Institute of Mining, Civil and Mechanical Engineers has just awarded prizes offered by the ex-president, Mr. J. H. W. Laverick, of Sheffield, and supplemented by the Institute, for the best papers offering suggestions for the utilisation of the Miners' Welfare Fund. This fund consists of payments by the owners at the rate of one penny per ton of coal raised during five years from 1920 and is estimated to yield about £1,000,000 annually. The first prize was awarded to Mr. C. C. Ellison, of New Monckton, who urged the allocation of the fund to the provision of baths at the pitheads in the interests of the miners' own health and comfort and improvement of home conditions. Mr. M. Robson, of Manvers Main, and Mr. C. S. Greaves, of Airedale Collieries, were adjudged equal second. The first advocated grouping of colliery villages for a common welfare centre, including the provision of baths, facilities for secondary education, religious organisations, sporting clubs, allotments, institutes, libraries, and reading rooms. Mr. Greaves' suggestions were on similar lines.

NORTH OF ENGLAND.

(From our own Correspondent.)

Improving Export Trade Position.

SIGNS are not wanting that manufacturers in the North of England are once again making a bold and determined effort to recapture lost overseas markets, and are meeting with a degree of success. A progressive improvement in this direction is generally expected. The pessimism which has prevailed for a considerable time past in the export trade has certainly given way to a more hopeful feeling, and the prospects are undoubtedly taking a more promising and definite shape, although there are still a large number of obstacles to surmount. A striking indication of returning prosperity is afforded by daily increasing pig iron exports. The foreigner is no longer in a position to flood the country with iron at a price below the home cost of production. On the contrary, he is finding that it pays him to purchase the better quality Cleveland pig iron. Not only Belgium, France, Holland, Switzerland and Italy, but Germany is coming into the Cleveland market for more and more iron. Even Krupps is a customer for Cleveland iron. The foreign exports of Cleveland iron for February were the heaviest for any month since April, 1920, the chief importers being Italy, 6700 tons; Belgium, 6336 tons; France, 4100 tons; Germany, 3136 tons; Switzerland, 2000 tons; and Holland, 1490 tons. There was a slight falling off in the trade with South Wales, but that was expected when the Welsh steel makers blew in their own furnaces. Scotland, however, continues to be a heavy customer, and last month 6000 tons were sent by sea. Unfortunately, the foreign shipments of manufactured iron and steel fell from 40,408 tons in January to 22,563 tons in February. India was the chief customer with 9464 tons, and the Argentine took 4948 tons and Natal 2137 tons.

Cleveland Iron Trade.

There is a lull in business in the Cleveland pig iron trade at the moment, though this is only what might be expected after the rather brisk buying movement of the past few weeks. The chief factors which have conspired to bring about this temporary quietness in market operations, however, are the labour troubles, and the increased cost of production due to dearer fuel. Hope is expressed that renewal of buying will not be long delayed. That there is confidence in the future is emphasised by the promised further expansion of production of pig iron by the blowing in of more idle furnaces. The Seaton Carew Iron Company has restarted a furnace on hematite, and one or two other firms have inoperative plant ready to set going as soon as the time seems opportune. There are now twenty-nine furnaces in blast on the North-East Coast—seven on Cleveland pig iron, nine on special kinds of iron, and thirteen on hematite. Although actual sales of pig iron just now are few, there are still a number of home and foreign inquiries circulating, and makers look for a growth in the continental trade. Though the agreed minimum prices for Cleveland iron have not been raised producers declare that advances will be essential if the present high cost of production is maintained. As, however, it is fully realised that an upward movement would be detrimental to the hope of steady revival, makers will do their utmost to avoid advances.

Hematite Pig Iron.

A very firm tone continues to characterise the East Coast hematite pig iron trade. The output is hardly sufficient to meet current needs, and some makers are so well sold that they cannot enter into any more contracts for delivery until the middle of April. Mixed numbers are firmly held at 100s. for early delivery.

Iron-making Materials.

There is practically no change in the position of the foreign ore trade, business being on a very limited scale. Best Bilbao Rubio ore is quoted at about 27s. per ton c.i.f. Tees, but South Spanish and Mediterranean ores are obtainable at a considerably lower figure. Blast-furnace coke is firm at 30s. delivered at the works.

Manufactured Iron and Steel.

There is little new of moment to report concerning the manufactured iron and steel trade. Some slight changes for the better are noticeable, but generally the situation continues unsatisfactory and discouraging. For export, manufacturers continue to quote well below the rates they adhere to for home business, and are stated to be securing a fair share of the limited foreign orders for which inquiries are circulated.

The Coal Trade.

The Northern coal trade continues to display remarkable firmness, not only for prompt, but also forward, and in some cases up to the end of the year. The question of American competition for the West European coal markets is again looming very large, with reports frequently coming to hand of success in obtaining contracts to the detriment of British competitors. At present, the American effort is chiefly concentrated on capturing the Italian trade, and the Americans appear to have achieved some success at prices and with conditions quite beyond the power of British exporters to counter. There is, of course, still a decided preference on the part of foreign buyers for British, and particularly North Country coal, but when the reduced quotations and risks of freight fluctuations are considered, together with the granting of long credit by the American exporters, it is not surprising that they are often successful in their efforts. The market for Northumberland and Durham coals is in all respects very steady, and assured for any loadings during the months of March and April. The output is gradually and consistently expanding, while with a good supply of prompt boats, the quicker dispatch at the staithes, and ample rolling stock, the trade situation for all prompt business is very satisfactory. The stream of inquiries from Holland, Denmark and Sweden is unabated, and is sufficient in itself to ensure stability for some time. The steam coal trade continues very brisk, and while the opinion has been expressed that the present values are the top, and that a reduction may be expected soon, there are no immediate possibilities of lower quotations. Gas coals are all strong, with best qualities commanding top figures. There is a good demand for coke. Every make is scarce, and any alteration will be in an upward direction.

SCOTLAND.

(From our own Correspondent.)

Outlook Brighter.

THERE seems to be a movement towards better trade in several branches of industry, and if the labour clouds at present on the horizon can be quickly dispelled better times would be considerably nearer. Foreign markets are becoming more active, and the home consumer is showing more interest. Any improvement noticeable so far is on a restricted scale, but nevertheless there is reason to hope for a substantial addition to business when labour questions are nearer settlement. Buyers are apparently more convinced that home prices have now reached the lowest minimum possible at present, and with local makers better able to give prompt deliveries, fewer orders are now finding their way to the Continent. At any rate, home makers are now receiving more consideration, even though the orders may be of small bulk as yet.

Discovery of Manganese Ore.

Reports are to hand of what promises to be a valuable deposit of manganese, which has been discovered in Strathnairn, about 6 miles from Inverness, and close to Culloden Moor Station, on the Aviemore and Inverness Railway. As shown by operations already carried out, the ore apparently covers a considerable area. One shaft has been sunk to a depth of 25ft., and a seam 7ft. thick has been struck without having been cut through. The samples analysed have proved to be of high grade and equal to the best Indian ore. The latest analysis shows 60 per cent. of ore, and mining operations are to be continued in order to ascertain the area covered by the ore. The discovery of the ore resulted from the work of a number of geologists who formed an association known as the Inverness Field Club. Mr. Thomas Wallace, a former rector of Inverness High School, and a member of this association, had his attention drawn to a dark-coloured rock in the bed of the Dalrey Burn, a small stream which runs into the river Nairn quite close to the Culloden Moor railway station. Samples of this rock were found to contain a high percentage of manganese. It is said that the commercial possibilities have attracted the attention of prominent men in the industrial world, who are prepared to finance the industry if future examinations bear out the promises of the present. The property on which the shafts have been sunk belongs to Miss Davidson, of Cantray, Nairn.

Pig Iron.

The Scotch pig iron trade is quiet, but more hopeful. The turnover is a little better, but still far below the average, and smelters can easily cope with the demand without re-lighting more furnaces. Though hematite is inclined to harden in price, quotations on the whole are disposed to ease somewhat owing to the recent concession in railway rates.

Steel and Iron.

Consumers of steel and iron are still buying in small quantities, and there seems to be a lingering hope that easier prices may yet be obtainable. In the meantime, steel prices, at least, are showing a hardening rather than a softening tendency, though perhaps more favourable terms might be possible were a particularly good specification to be on offer. The fact that more consumers are now placing their requirements with home makers gives a certain amount of hope that ere long the mills will be in receipt of larger orders. More establishments are now in operation, and considerable difficulty is experienced in maintaining employment. Steel plates do not find much business, and sectional material is far from busy. Sheets of all descriptions are busier in the export department, but the home market is slow to move. The ironworks have not reaped much benefit yet from the reduction in price, and fairly cheap rates are occasionally quoted to induce business. Generally speaking, however, things are beginning to move slightly, and in view of this it is hoped that the wages disputes in the engineering and shipbuilding trades may be amicably settled.

Coal.

Conditions in the Scotch coal trade continue to improve. There is now a steady output from the collieries, and most descriptions are readily disposed of. Home sales are not satisfactory, but the export inquiry is expanding. In the West of Scotland splints and ells are booking more orders, and washed materials are busy. In the Lothians and Fifeshire all sorts of fuel, with the exception of drosses, have good orders for shipment. France and Italy are buying good quantities, and occasional cargoes are going to South America. Dutch buyers, also, are fairly active. Prospects for the next month or two at least are much brighter. Tonnage is now in better quantity, and shipments are more regular. The aggregate clearances for the past week amounted to 251,616 tons against 210,700 tons in the preceding week, and 305,616 tons in the same week in 1913.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

On the whole the steam coal trade displays no new feature, and fully maintains the improvement which has been so conspicuous during the past fortnight, although there are signs that increasing output is being accompanied by enhanced difficulties in securing rapid shipment at the docks. This will inevitably be reflected sooner or later in irregularity in prices, as collieries that are unable to find an immediate outlet for their coals will be induced to make concessions to those buyers who can take prompt delivery in order to clear wagons and enable the pits to continue working without interruption. There are now strong complaints regarding the delays to tonnage, though, of course, responsibility for this is variously apportioned, some attributing it to the slow work at the docks, and others to the fact that coals are a long time getting to the ship side. Certainly the view mostly held is that conditions would be very much better if the working hours were revised and loading operations were carried on all round the clock. If production is to expand and the coal trade is to have an unfettered chance of getting back to pre-war prosperity, steps will have to be taken to improve the facilities for shipment. Meanwhile the market for steam coals is quite good, and prices are well upheld. The inquiry from abroad is very satisfactory, and many buyers are now coming along ready to pay the prices which they declined to consider a few weeks ago. Tenders had to be in on Tuesday last for 170,000 tons of best steam coals for the Bombay and Baroda Railway. Prices were asked for c.i.f. Bombay, the delivery being from June to December next, inclusive. Four cargoes monthly are required from June to September inclusive, and two cargoes per month from October to December inclusive. A good deal of interest is displayed in this business. The conditions prevailing now are very different to those in existence when this railway company last came into the market. The last contract did not turn out very satisfactory for those who took the business, and it is fully expected that prices on this occasion will be much higher. It is very difficult to say what the second half of this year has in store for the coal trade, and in quoting for the order contractors have to speculate to what extent present prices of coal and present rates of freight can be discounted. Other inquiries on the market are for the most part for single cargoes, although the Norte Railway of Spain and the Algerian Railway are asking for prices for fair supplies of coal and patent fuel.

Finances of the Industry.

The certificate of the joint auditors setting forth the proceeds and costs in South Wales for January last and showing the percentage payable to the workmen as from the 1st inst. was received last week. After allowing for the cost of standard wages, other costs and the owners' standard profits of 17 per cent., the certificate shows that the percentage on the 1915 standard base rates which the industry can afford to pay for this month is 11 per cent. After meeting the cost of standard wages, other costs, and providing for the owners' standard profit, the surplus available is £85,000, and under the terms of the national agreement this sum is divisible in the proportion of 83 per cent. to the workmen and 17 per cent. to the owners. The first charge on the industry, however, is the minimum wage of 28 per cent. on the 1915 standard base rates. The proceeds in January were not sufficient to enable the owners to pay this minimum without having to sacrifice not only their share of the surplus but practically the whole of their standard profits for the month of January. This means that with respect to January the owners suffer a loss under the agreement of no less than £262,000. In their efforts to recover the export trade the owners, in the three months of November, December and January, have suffered a loss of £850,000. The workmen, however, receive the minimum that was guaranteed under the terms of the national settlement, and during December and January benefited by more regular work than any other coalfield in the country, as in December (excluding the Christmas holidays) the number of days worked was 5.55 per week, and in January about 5.51 days per week.

Non-unionism.

Reference has been made on a previous occasion to the threatened trouble in the coalfield on the non-unionist question, but it is to be doubted whether anyone thought that the position was as bad with the Miners' Federation as is really the case. According to a statement by the President of the South Wales Miners' Federation, the majority of the men in the coalfield are non-unionists. More than half the men employed in the mines are outside the Miners' Federation, and before they can do anything to remedy the present state of things Mr. Hartshorn says that they must rebuild the Federation and have it as efficiently organised as it was in pre-stoppage days. He believes that with an efficient organisation there are ways and means of getting a higher wage than the miners enjoy to-day. Coalowners, however, are not likely to admit his claim that no colliery owner has the right to say to the miner that it must be left to them to say how coal is to be disposed of and what wages the miner is to receive. His contention is that the miners are entitled to say that their services are indispensable to the community, and that they demand in return for those services that they and their families should be assured of a decent civilised existence. No owner will quarrel with this view, but the miners cannot get more out of the industry than it can afford to pay, and it is going a little too far when it is put forward seriously that the miners shall say how coals are to be disposed of.

Ship-repairing Work.

There is a stoppage of work on the part of the shipwrights in this district. The men recently discussed whether work should be resumed on a reduction of 12½ per cent. on both day and piece rates pending negotiations with a view to a final settlement, but it was decided not to act on this recommendation. The action on the part of these workmen is seriously prejudicing the ship-repairing industry, and the result is inevitably that ships which want dry-docking and repairing are going away without the work being done. In spite of the trouble experienced recently about orders going abroad, it is noteworthy to find that the Penarth Pontoon Company has lately performed a very creditable operation. Invitations were extended to forty-two firms throughout the country to tender for the repairs to the s.s. Pengelly, a vessel of 5900 tons deadweight. Competition was very keen, but the Penarth Pontoon Company secured the order and undertook to complete the necessary work in twenty-three days, whereas other Bristol Channel firms quoted times ranging from thirty to thirty-five working days. As a matter of fact, the Penarth Pontoon Company actually did the work in nineteen days and thereby earned a substantial premium for each day saved on the contract time.

Current Business.

Colliery stems are very full for prompt loading, and as a consequence few undertakings can entertain any fresh business, and they are certainly not discounting present prices for loading ahead. As a matter of fact, many collieries have sufficient orders on their books for the whole of this month, and in some cases salesmen have sold all the coal they care to commit themselves to from now up to the end of May. Unfortunately the loading of their coals does not always proceed as smoothly as they desire, as the facilities at the docks are not all that they could be, and the result is that although they may be well sold, they cannot get wagons cleared promptly owing to their tonnage not being in berth. In such cases salesmen are inclined to let parcels go at a shade lower than current values to those buyers who can take spot lots, but there are very few buyers who are in this fortunate position. Best Admiralty large is quoted up to 27s. 6d. and second qualities at 27s. Superior Monmouthshire large coals command up to 26s. 6d., but small coals are not quite so strong, as the result of the increased output of large coals is that smalls are more plentiful. Best smalls are about 19s. 6d. to 20s. Sized coals are very firm and scarcely obtainable for shipment this month, while highly bituminous coals are much in the same category. Patent fuel is also firm at prices ranging from 25s. to 28s. Patent fuel workers at Cardiff have agreed to a reduction in wages of 15 per cent. in two cuts, the first of 10 per cent. to operate from Monday last, and the second of 5 per cent. from April 17th next. Patent fuel makers have formed an Association called the South Wales Patent Fuel Manufacturers' Association, for the purpose of protecting their interests. Mr. T. Hughes Rice, of the Phœnix Patent Fuel Company, Swansea, is the first chairman.

Latest News from the Provinces.

WALES AND ADJOINING COUNTIES.

Shipwrights' Dispute.

A JOINT conference was to have been held on Wednesday, but owing to the men withdrawing their labour it was abandoned.

Swansea Metal Exchange.

The tin-plate market continues quiet. Very little fresh business is being done, though the market is no weaker. Production is about 50 per cent. of the normal. Up to now the strike of chemical workers has not materially affected the tin works that are engaged. Sheets and tin bars are unaltered at £7 7s. 6d. per ton delivered, but reports are current of a possible advance in price.

THE MACHINE TOOL TRADES' ASSOCIATION.

THE annual meeting of the Machine Tool Trades' Association was held in London on Wednesday. At the end of 1921, according to the Council's report for that year, the membership of the Association comprised 142 firms. During the year twelve firms resigned their membership, in consequence in nearly every instance of their having ceased to be machine tool makers. Full permission, the report records, was granted to members to participate in any exhibition promoted by the Society of Motor Manufacturers and Traders, the Ironmongers' Federated Association, the Association of Model Engineers, the Royal Agricultural Society, the Smithfield Club, the British Science Guild, and the Wholesale Hardware Association. On the other hand, the full penalty of £100 was imposed upon a member—now resigned—for participating in the Glasgow Engineering and Shipbuilding Exhibition. In another case in connection with the same Exhibition, an apology was accepted, together with a modified penalty. In a third instance, the Council accepted the firm's explanation that its machines were exhibited against its express wish. The Association has decided not to support the British Empire Exhibition on the grounds that any results obtained would in all probability, in view of the length of time—six months—for which the Exhibition is to be open, be quite out of proportion to the expense involved.

The Association does not, of course, confine its activities to the control of exhibitions, although it was for that purpose that it was originally brought into being. The annual report reveals an extensive range of other matters in which it seeks to protect and promote the interests of the machine tool trade. As a member of the Federation of British Industries, the Association has acted with that body in connection with works "beanfeasts," compulsory continued education, fees for specifications, civil work in Government Arsenals, Government contract conditions, port and warehouse charges, overseas advertising and other matters. It has, in addition, rendered direct assistance to individual members in their dealings with Government Departments, has engaged in discussions with the Disposals Board regarding the effect of selling the Government's stocks of surplus machine tools, has succeeded in securing a reduction in the employers' liability insurance premiums paid by many of its members, and has taken steps to have the machine tool trade brought within the scope of the Safeguarding of Industries Act, 1921.

The annual dinner of the Association was held at the Trocadero, London, on Wednesday evening, Sir Alfred Herbert, the President, being in the chair. Among those who attended were Mr. Stanley Baldwin, the Earl of Malmesbury, Mr. G. H. Roberts, Sir Howard Frank, and Colonel O. C. Armstrong.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

WE are asked to state that Mr. Alex. Spencer has been appointed vice-chairman of the Metropolitan-Vickers Electrical Company, Limited, succeeding the late Sir Francis Barker in that position.

THE FABRIQUE DE PORCELAINE LANGENTHAL, S.A., Langenthal, Switzerland, has appointed Burlectas, Limited, 11, Pancras-lane, E.C. 4, its agent for Great Britain for the sale of its products.

JOHN I. THORNYCROFT AND CO., Limited, inform us that their head office is now at Thornycroft House, Smith-square, Westminster, S.W. 1. Telephone, Victoria 8000; telegrams "Thornycroft, Vic, London."

MR. GEORGE RICHWOOD has relinquished his position as sales manager to Millars' Timber and Trading Company, Limited (Machinery Department), in order to take over the management of the constructional machinery department of Gaston, Limited, Larden-road, Acton Vale, London, W. 3.

WE are informed that the Considère Construction Company, Limited, which for the past fourteen years has developed in the British Isles the Considère system of reinforced concrete design, proposes to pool resources with the French firm of Pelnard-Considère and Caquot. We understand that the matter is at present in the early stages.

ALFRED HERBERT, Limited, inform us that they have been appointed exclusive agents in India, Burma and Ceylon for the sale of semi-Diesel marine and stationary oil engines manufactured by Plenty and Son, Limited, Eagle Ironworks, Newbury. This agency will be handled by their associate company, Alfred Herbert (India), Limited, at Calcutta, Bombay, Lahore, Madras and Rangoon.

WE are informed that the partnership previously existing between Mr. A. S. Russell and Mr. H. F. Moore, trading as Firth and Russell, Sterling Works, Shafton-lane, Holbeck, Leeds, was dissolved by mutual consent as from January 20th, 1922, Mr. A. S. Russell retiring from the firm. The business will be continued by the remaining partner, Mr. H. F. Moore. It will be carried on as formerly under the same style of Firth and Russell, and at the same address.

WE are asked to state that arrangements in connection with the manufacture of opposed piston internal combustion engines of the Doxford type in America have recently been concluded, William Doxford and Sons, Limited, of Sunderland, having agreed with the Sun Shipbuilding Company, of Chester, Pennsylvania, to unite the interests of the American Junker patents with those of the Doxford patents on which the development of the Doxford opposed piston oil engine have been based. The Sun Company, of Chester, has already secured the full licence for America and its possessions of the Junker patents, and will operate both interests in America.

INSTITUTION OF PETROLEUM TECHNOLOGISTS.—The fourth annual dinner of the Institution of Petroleum Technologists will be held at the Connaught Rooms, Great Queen-street, W.C. 2, on Tuesday, March 21st. Tickets can be obtained from Mr. William Sutton, 17, Gracechurch-street, E.C. 3, who is acting as honorary secretary to the Dinner Committee in the absence of Mr. Ashley Carter.

HELICOPTER PRIZE.—The Air Ministry announces that the Air Council has under consideration the offer of a prize of £50,000 for a helicopter flying machine which complies with certain tests. The conditions under which entries will be received will be announced at a later date, and until that announcement is made no application or inquiries on this subject can be dealt with, whether made personally or in writing.

BRUSSELS COMMERCIAL FAIR.—The third official Commercial Fair, which is organised by the municipality of Brussels, under the patronage of the King of the Belgians and in collaboration with the Government, the Province of Brabant, and the suburbs of the city, will be held in the gardens of the Cinquantenaire Park from April 3rd to 19th next. The organising committee is, it is interesting to note, presided over by Monsieur Max, the famous Burgomaster of Brussels. The Fair is international in character. Further particulars may be obtained on application to the head office, No. 19, Grand Place, Brussels.

THE ROYAL GOLD MEDAL FOR ARCHITECTURE.—At a general meeting of the Royal Institute of British Architects, on March 6th, Mr. Thomas Hastings, of New York, was elected by the members and his name will be submitted to his Majesty the King as a fit recipient of the Royal Gold Medal for Architecture for the year 1922. In the event of his Majesty signifying his approval of the award, the medal will be presented to Mr. Hastings at a formal meeting on June 26th. Since the institution of this medal by Queen Victoria in 1848 it has only been conferred on American architects on two previous occasions. In 1893 it was awarded to Richard Morris Hunt and in 1903 to Charles Follen McKim.

ROYAL SANITARY INSTITUTE CONGRESS.—The Lord Mayor of London and the Lady Mayoress will attend the thirty-third congress of the Royal Sanitary Institute, which will be held at Bournemouth from July 24th to the 29th next, and will act as hon. presidents of the Conference of Representatives of Sanitary Authorities and Section C, Personal and Domestic Hygiene. Among the official delegates appointed to attend the meeting representatives will be present from the New South Wales Government, the State of Victoria, the Adelaide City Council, the Hobart Town Council, the Quebec Provincial Government, the Kimberley Municipality, the Port Elizabeth City Council, the Hong Kong Sanitary Department, the Shanghai Municipal Council, the Danish Public Health Department, the Singapore Municipal Commissioners, and from the Ceylon Medical College.

CONTRACTS.—Associated British Manufacturers (Egypt), Limited, the head office of which is at Cairo and its London office at 8, The Sanctuary, Westminster, has been awarded the contract for the supply and installation of pumping machinery at Atf in Lower Egypt. The value of the contract is slightly over £70,000. It was keenly competed for by Swiss, German, French, Dutch and other manufacturers.—We understand that the Wellman Smith Owen Engineering Corporation, Limited, of London and Darlaston, has secured a contract from the Steel Company of Scotland, Limited, of Glasgow, for gas producer plant, consisting of seven Wellman mechanical producers, complete with bunkers, mechanical feeds, gas mains, &c.—The E. W. Harvey Gas Furnace Company, Limited, of 70, Victoria-street, Westminster, has received through its Glasgow representatives, Messrs. Gillespie Bros. and Co. an order for one of its regenerative gas plate heating furnaces with a gas producer, from Orr, Watt and Co., Limited, of Motherwell.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	28/-
(1) Spanish	28/-
(1) N. African	28/-
N.E. Coast—	
Native	—
Foreign (c.i.f.)	27/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) **Scotland—**		
Hematite	5 7 6	—
No. 1 Foundry	5 2 6	—
No. 3 ,,	4 17 6	—
N.E. Coast—		
Hematite Mixed Nos.	5 7 6	5 7 6
No. 1	5 10 0	5 10 0
Cleveland—		
No. 1	4 15 0	4 15 0
Silicious Iron	4 15 0	4 15 0
No. 3 G.M.B.	4 10 0	4 10 0
No. 4 Foundry	4 7 6	4 7 6
No. 4 Forge	4 2 6	4 2 6
Mottled	3 15 0	3 15 0
White	3 15 0	3 15 0
Midlands.		
Staffs.—		
All-mine (Cold Blast)	13 0 0	—
Part Mine Forge	*None offering.*	
North Staffs. Foundry (*Nom.*)	4 10 0	—
(3) Northampton—		
Foundry Nos. 2 and 1	*Nominal.*	
,, No. 3	4 0 0	—
,, Forge	3 10 0 to 3 12 6	
(3) Derbyshire—		
No. 3 Foundry	4 2 6 to 4 5 0	
Forge	3 15 0	—
(3) Lincolnshire—		
Basic	4 0 0 to 4 5 0	
Foundry	4 5 0 to 4 10 0	
Forge	4 2 6 to 4 5 0	
(4) N.W. Coast—		
N. Lancs. and Cum.		
Hematite Mixed Nos.	5 10 0 to 5 15 0	

MANUFACTURED IRON.

	Home. £ s. d.	Export £ s. d.
Scotland—		
Crown Bars	11 10 0	—
Best ,,	12 0 0	—
N.E. Coast—		
Common Bars	12 0 0	—
Marked ,,	17 10 0	—
Tees	14 10 0	—
Lancs.—		
Crown Bars	12 0 0	—
Hoops	14 0 0	13 15 0
S. Yorks.—		
Crown Bars	12 0 0	—
Best ,,	13 0 0	—
Hoops	14 0 0	—
Midlands—		
Marked Bars (Staffs.)	14 10 0	—
Crown Bars	12 0 0 to 12 10 0	
Nut and Bolt Bars	10 15 0 to 11 0 0	
Gas Tube Strip	12 10 0	—
Hoops (*Nom.*)	14 0 0 to 15 0 0	

STEEL.

	(5) Home. £ s. d.	(7) Export. £ s. d.
(5) **Scotland—**		
Boiler Plates	14 0 0	—
Ship Plates ⅜in. and up	10 10 0	—
Sections	10 0 0	—
Steel Sheets ⅛in. to ⅜in.	11 15 0	—
Sheets (Gal. Cor. 24 B.G.)	—	16 10 0

STEEL (*continued*)

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	10 10 0	—
Angles	10 0 0	—
Boiler Plates	16 0 0	—
Joists	10 10 0	—
Heavy Rails	9 10 0	—
Fish-plates	14 10 0	—
Channels	14 10 0	—
Hard Billets	9 5 0	—
Soft Billets	7 5 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	9 10 0	—
Light ,,	11 0 0 to 13 0 0	
Billets	9 5 0	—
Ship Plates	10 10 0	—
Boiler ,,	14 10 0	—
Manchester (*Prices irregular and uncertain, unchanged*)—		
Bars (Round)	10 0 0 to 12 0 0	
,, (others)	11 0 0 to 12 0 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	12 5 0	12 0 0
Plates	£10 to 12	10 0 0
,, (Lancs. Boiler)	16 0 0	—
Sheffield—		
Siemens Acid Billets	10 0 0 to 11 0 0	
Bessemer Billets	12 10 0	—
Hard Basic	9 5 0	—
Soft ,,	7 10 0 to 8 10 0	
Hoops	12 5 0	—
Soft Wire Rods	11 0 0	—
Midlands—		
Small Rolled Bars	9 10 0	—
Bessemer Billets	7 10 0 to 8 0 0	
Hoops	12 0 0	—
Gas Tube Strip	10 5 0 to 10 10 0	
Sheets (24 W.G.)	14 0 0	—
Galv. Sheets (f.o.b. L'pool)	16 0 0 to 16 10 0	
Angles	10 0 0	—
Joists	10 10 0	—
Tees	11 0 0	—
Bridge and Tank Plates	10 10 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	18/6 to 19/-
Block Tin (cash)	142 0 0
,, (three months)	144 0 0
Copper (cash)	60 2 6
,, (three months)	61 2 6
Spanish Lead (cash)	20 12 6
,, (three months)	20 10 0
Spelter (cash)	25 7 6
,, (three months)	25 10 0
Manchester—	
Copper, Best Selected Ingots	65 0 0
,, Electrolytic	66 10 0
,, Strong Sheets	90 0 0
,, Loco Tubes	0 1 1½
Brass Loco Tubes	0 0 11½
,, Condenser	0 1 2½
Lead, English	22 10 0
,, Foreign	20 15 0

FERRO ALLOYS.

(*All prices now nominal*).

	Per Ton.	Per Unit
Tungsten Metal Powder	1/8 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£27	10/-
,, 6 p.c. to 8 p.c. ,,	£26 10 0	9/-
,, 8 p.c. to 10 p.c. ,,	£25 10 0	8/-
,, Specially Refined		
Max. 2 p.c. carbon	£70	26/-
,, 1 p.c. ,,	£88	30/-
,, 0·75 p.c. carbon	£108	37/-
,, carbon free	2/- per lb.	
Metallic Chromium	5/8 per lb.	
Ferro Manganese	(per ton) £15 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£13 0 0 scale 5/- per unit	
,, ,, 75 p.c.	£25 10 0 scale 6/- per unit	
,, Vanadium	20/- per lb.	
,, Molybdenum	7/- per lb.	
,, Titanium (carbon free)	1/3 per lb.	
Nickel (per ton)	£180	
Cobalt	14/- per lb.	
Aluminium (per ton)	£110 to £120 (British Official).	

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	22/-
,, ,, Ell	22/3
,, ,, Splint	23/6 to 26/3
,, ,, Trebles	24/6
,, ,, Doubles	22/3
,, ,, Singles	19/-
Ayrshire—	
(f.o.b. Ports)—Steam	22/-
,, ,, Splint	23/6
,, ,, Trebles	24/6
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	20/- to 23/-
Screened Navigation	26/-
Trebles	25/-
Doubles	22/3
Singles	19/-
Lothians—	
(f.o.b. Leith)—Best Steam	22/6
Secondary Steam	22/-
Trebles	25/-
Doubles	23/-
Singles	19/-

ENGLAND.

(8) **N.W. Coast—**	
Steams	33/-
Household	40/- to 55/-
Coke	34/-
Northumberland—	
Best Steams	25/- to 26/-
Second Steams	23/- to 23/6
Steam Smalls	14/- to 15/-
Unscreened	21/6
Household	28/- to 30/-
Durham—	
Best Gas	23/- to 23/6
Second	21/- to 22/-
Household	25/- to 30/-
Foundry Coke	38/- to 40/-
Sheffield—	**Inland.**
S. Yorks. Best Steam Hards	22/- to 24/- —
Derbyshire Hards	21/- to 22/- —
Seconds	21/- to 22/- —
Cobbles	21/- to 22/- —
Nuts	18/- to 19/- —
Washed Smalls	12/- to 15/- —
Best Hard Slacks	13/- to 14/- —
Seconds ,,	10/- to 11/- —
Soft Nutty ,,	9/- to 10/- —
Pea ,,	7/- to 8/- —
Small ,,	5/- to 6/- —
House, Branch	37/- to 39/- —
,, Best Silkstone	34/- to 36/- —
Blast Furnace Coke (Inland and Export)	17/6 to 25/-

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	27/- to 27/6
Second ,, ,,	26/6 to 27/-
Best Dry Large	26/6 to 27/-
Ordinary Dry Large	25/6 to 26/-
Best Black Vein Large	26/6 to 27/-
Western Valley ,,	26/- to 26/6
Best Eastern Valley Large	26/- to 26/6
Ordinary ,, ,,	24/- to 25/-
Best Steam Smalls	20/- to 21/-
Ordinary ,,	18/- to 20/-
Washed Nuts	27/6 to 35/-
No. 3 Rhondda Large	30/- to 32/6
,, ,, Smalls	19/- to 20/-
No. 2 ,, Large	23/6 to 24/-
,, ,, Through	20/- to 22/-
,, ,, Smalls	16/- to 18/-
Coke (export)	32/6 to 35/-
Patent Fuel	26/- to 28/-
Pitwood (ex ship)	31/6 to 32/-
Swansea—	
Anthracite Coals:	
Best Large	37/6 to 40/-
Seconds	30/- to 35/-
Red Vein	29/- to 30/-
Big Vein	37/6 to 40/-
Machine-made Cobbles	50/- to 52/6
Nuts	57/6 to 60/-
Beans	47/6 to 50/-
Peas	20/- to 22/6
Breaker Duff	9/- to 9/6
Rubbly Culm	13/- to 14/-
Steam Coals:	
Large	22/6 to 25/-
Seconds	20/- to 22/6
Smalls	12/6 to 15/-
Cargo Through	18/6 to 20/-

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—F.O.B. Glasgow.

(8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

French Engineering Notes.

(From our Correspondent in Paris.)

Coefficients.

SIGNS of a possible change in the fiscal policy of this country are observable, first, in the statement alleged to have been made by M. Poincaré at the recent Boulogne conference to the effect that France would do her best to help solve the problem of unemployment in England by facilitating trade between the two countries and, then, by the report that the Commission appointed to revise the coefficients has reduced them except in a few special cases. Such concessions to foreign trade, if they are made, are all the more noteworthy for the reason that the protectionist propaganda have been steadily increased with a view, apparently, of reminding the Commission of Coefficients that the interests of the new French industries must not be sacrificed. On every side there are complaints that home industries are handicapped because the import duties are not high enough to keep out foreign goods. This confession would imply that if manufacturers are unable to make headway now they are not likely to do much in the future, since, with an improving exchange rate, they will lose much of their present advantage, and the fiscal problem will become extremely complicated if the duties are to be constantly adjusted to the fluctuations of monetary values. If the economical situation is to be governed by the protection of home industries there can never be any improvement, for the reason that the continual putting up of duties to compensate for the appreciation of the franc would effectually check the importation of manufactured goods which would necessarily have a repercussion upon the export trade. If the question of trade expansion is left to the home manufacturing interests, except, it may be, the silk and other essentially French industries, there will be no trade at all. The only hope lies in the carrying out of some amicable and equitable arrangement between the two countries, based more or less upon political necessities, and it is with the idea of safeguarding the general interests of the country that the French Government is apparently disposed to offer wide concessions to British trade. The report that the Commission has effected a general reduction in the coefficients would seem to confirm the impression that a more liberal policy is to be adopted.

The Rhone Scheme.

The preliminary negotiations for the constitution of the Compagnie Nationale du Rhône to carry out the vast undertaking for the utilisation of the river Rhone for the production of electrical energy, for irrigation, and for rendering the river navigable its whole length, are now completed, the various interests involved having come to an agreement for carrying out the three phases of the programme simultaneously. The first part of the undertaking will be the carrying out of the hydraulic works at Génissiat and Donzière-Mondragon and the laying out of the port of Lyons. At the same time high-tension mains will be run from Génissiat to Paris and Arles. The character of the irrigation works will depend largely upon the requirements of the different districts which are to be supplied with water, and associations recognised by the Minister of Agriculture can at any time apply for the immediate construction of irrigation canals and pumping stations, for which current will be supplied at very low cost. The first part of the programme is estimated to cost 1150 million francs out of a total of 3300 million francs. The success of the enterprise, however, depends largely upon the raising of the level of Lake Geneva. Most of the Swiss cantons interested have given their consent, but some are proving refractory, and the French Government is making great efforts to overcome their objections, which do not appear to be of a technical character, since the reports of French engineers have proved conclusively that there can be no danger, or even inconvenience, in raising the level sufficiently to provide a larger volume for the Rhone. If the Swiss objections are maintained they will seriously compromise the success of the scheme.

Electric Train Lighting.

After the Batignolles tunnel disaster the Minister of Public Works reminded the railway companies that orders had been issued by his department before the war for the entire suppression of gas lighting on trains, the catastrophes at Melun and elsewhere having proved that the carrying of cylinders with gas under pressure constituted a serious danger. He therefore insisted on all the trains being equipped with electric lighting sets by the end of the present year. Since then the Etat railways have been experimenting with various systems, and the first electrically lighted train was put in service last week between Paris and Versailles with complete success. The work of transformation is to be continued so that the whole of the suburban trains will be equipped electrically by the end of the year. As the suburban lines themselves are being electrified, the lighting equipments will be available subsequently for the main lines.

Electrical Costs.

The Superior Council of Public Works has prepared a programme for the construction of generating stations having a total power of 1,370,000 kilowatts and of 15,000 kiloms. of high-tension mains. The cost is estimated at about 15,000 million francs, to be spread over a period of fifteen years. Apparently the scheme has been prepared in pursuance of the policy of rendering the country independent of imported fuels, but there seems very little chance of its execution being seriously entertained for a long while to come. Meanwhile, the idea that electrical distribution would provide plenty of cheap energy has not so far been justified, and users are complaining more and more of the higher prices charged by the electrical distribution companies, which explain that they have no alternative but to raise their rates in view of the increasing charges imposed upon them. The fact that the cost of current should be advancing while the prices of coal and other fuels are diminishing is raising doubts amongst consumers whether the general electrification of the country will enable them to realise serious economies.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

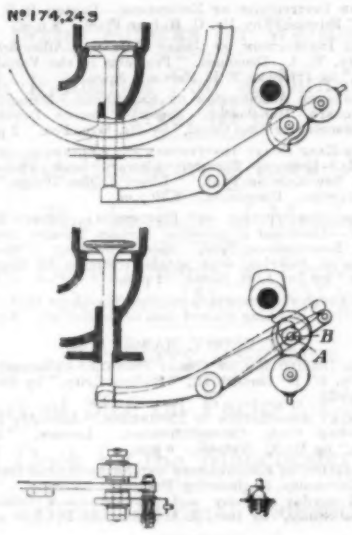
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

174,249. November 15th, 1920.—COMPRESSION RELEASE DEVICES, W. Scholes and H. R. Hall, Victoria Works, Denton, Manchester.

This valve gear is intended to stop the engine in the event of it tending to run away. On the valve lever there is a tumbler piece A, which pivots about B and is so weighted that it naturally hangs in the position shown in the lower view, when the exhaust valve of the engine is kept off its seating and the engine must

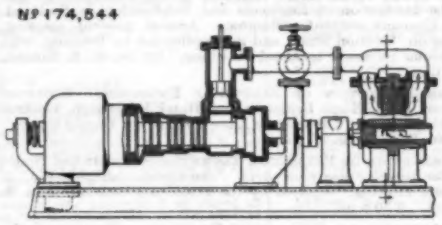


stop. During normal running the tumbler is held in the position shown above by a spring catch, but if a predetermined speed is exceeded the inertia of the counterweight on the tumbler overcomes this catch and the tumbler swings into the operative position.—*January 26th*, 1922.

TURBINE MACHINERY.

174,544. April 1st, 1921.—HIGH-TEMPERATURE TURBINES, N. Tesla, 8, West Forthieth-street, New York.

With the idea of employing steam temperatures as high as 1100 deg. Fah., the inventor uses two turbines in series. The first machine, shown on the right of the drawing, comprises

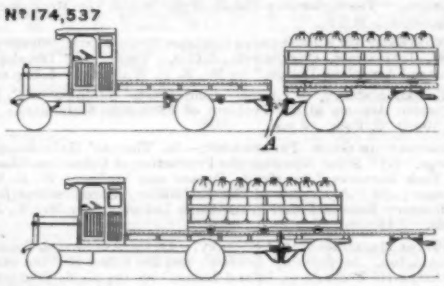


a set of plain discs on a shaft, which are rotated by the friction of steam jets. The exhaust from this machine is taken at a temperature of about 550 deg. Fah. to another turbine of the Parsons reaction type.—*February 2nd*, 1922.

MOTOR CARS AND ROAD TRAFFIC.

174,537. March 1st, 1921.—TRANSFERRING LOADS TO AND FROM VEHICLES, J. I. Thornycroft and Co., Limited, 10, Grosvenor-place, Westminster, and V. G. Barford, Basingstoke.

In order to facilitate the transfer of a load from one vehicle to another or to a fixed dock, the inventors bring the two platforms to the same level. Different means for effecting the

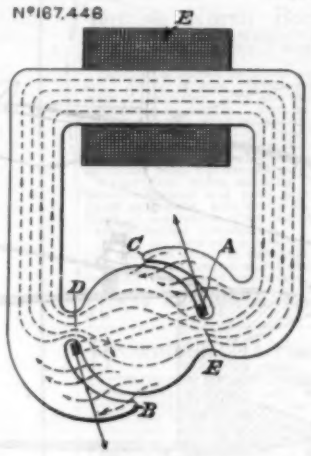


purpose are described, and one of them is illustrated herewith. Both vehicles are provided with hinged links A A, which are coupled together when the vehicles are a short distance apart. The wheels of the trailer are then chocked, and the lorry is backed up against it, when the links have the action of bringing the two platforms to the same level, and the load can be easily transferred, as shown in the lower illustration.—*February 2nd*, 1922.

SWITCHGEAR.

167,446. November 18th, 1920.—IMPROVEMENTS IN ALTERNATING CURRENT RELAYS, McKenzie, Holland and Westinghouse Power Signal Company, Limited, of 58, Victoria-street, S.W. 1.

The relay described in this specification is claimed to be particularly suitable for the control of electric or pneumatic motors for operating railway points and signals. The movable element A consists of a copper ring capable of being displaced in the slots of the magnetic coil, and the ring is subjected to a controlling couple, which may consist of a spring or a weight. The effect of the horns B and C and the constrictions D and E is to cause considerable magnetic leakage in the slots, and the total flux is thus divided into two parts, a flux passing through

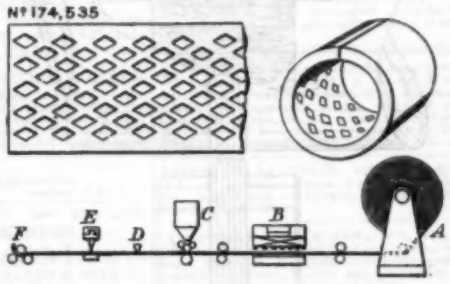


the movable ring and the leakage or "motor" flux. The action of the former is to set up an alternating current in the ring A, whilst the action of the latter flux is to react upon this current, so as to cause the ring to rotate in a direction opposite to that of the controlling couple, which is indicated by the long arrows projecting from the ring A. When the exciting coil is de-energised the electro-magnetic forces cease to act on the ring and the ring takes up the position shown, but when the current is switched on to the coil E the ring turns, and it will readily be understood that its movement can be made to actuate electrical contacts, a mechanically operated valve or other arrangement.—*January 26th*, 1922.

TRANSMISSION OF POWER.

174,535. February 25th, 1921.—SELF-LUBRICATING BEARINGS, *W. J. Mellersh-Jackson*, 28, *Southampton-buildings, London*.

A strip of metal A is fed through dies B, which indent its surface, as shown in the detail drawing. The strip then passes between rollers C, which fill the indentations with a lubricant

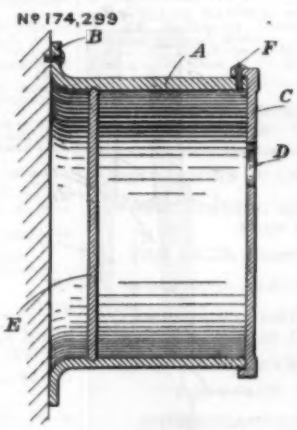


such as graphite. The surplus graphite is scraped off by a knife D, and the strip is cut into lengths by the shears E. The sections are then formed into cylindrical bushes by the rolls F, and are finally heated and pressed to harden the lubricating material.—*February 2nd*, 1922.

MEASURING AND TESTING INSTRUMENTS.

174,299. March 27th, 1921.—IMPROVEMENTS IN CASINGS FOR VOLTMETERS, AMMETERS AND SIMILAR INSTRUMENTS, Tubes, Limited, of Rocky-lane, Aston, Birmingham, and Ernest William Poole Lines, of 57, Wheelwright-road, Gravelly Hill, Birmingham.

The instrument case to which this invention relates comprises a



cylindrical body A with a flange B at the back. To the front of the body is attached a front plate C which has a slot D through which the pointer of the voltmeter or other instrument can be seen. The mechanism of the instrument is attached to the

back plate E, which has to be drilled at various points for the reception of screws. Usually the parts A, B and E are formed integral in a casting and the front plate C is attached by means of screws such as those shown at F. The process of manufacturing instrument cases of this kind is fully described.—*January 26th*, 1922.

AIRCRAFT.

152,610. October 15th, 1920.—ADJUSTABLE PLANES, Société Anonyme des Etablissements Nieuport, 40, Boulevard du General Gallieni, Issy-les-Moulineaux, France.

IN order to facilitate the adjustment of aeroplane wings, with respect to their longitudinal equilibrium, the inventors attach narrow strips of resilient metal to the front edges of the planes.

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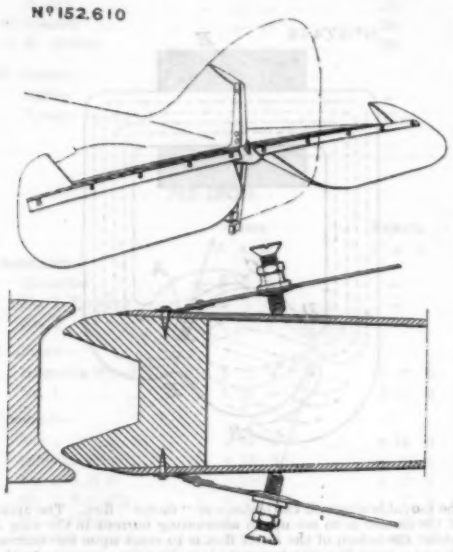

The angle which these strips make with the axis of the wing can be varied to adjust their effectiveness. The upper illustration shows the strips applied to the rear movable planes of a machine, while the lower view indicates the method of adjustment.—*January 16th*, 1922.

MISCELLANEOUS.

174,484. November 16th, 1920.—PIPE JOINTS, A. Andresen Rosario Waterworks, Argentine Republic.

The inventor proposes to make the joints between concrete water pipes by means of short wooden staves, as shown in the

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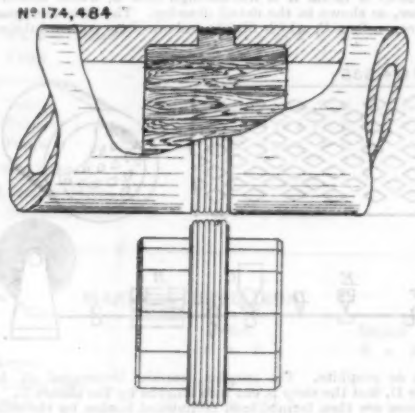

illustration. The staves are held together by a wire binding, and are put in place dry. When they are wetted they swell and make a tight joint, but permit slight movements of the pipes.—*February 2nd*, 1922.

152,650. October 18th, 1920.—PROCESS OF AND RETORT FOR DISTILLATIONS OF FUELS, Colombo de Bartolomeis, of 7, Via Napo Torriani, Milan, Italy, and Remo de Bartolomeis, of the same address.

The retort described in the specification is composed of an

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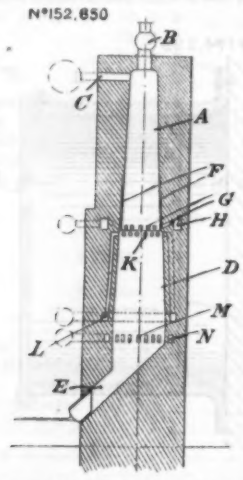

upper chamber A into which the fuel to be treated is charged. B is a charging hopper, which can be sealed, and C the passage through which the gases pass. At the base of the retort there is another chamber which terminates in a passage E for the discharge of the materials. In the lower distillation zone of the chamber A electric heating arrangements F are placed, whilst at the base of this chamber there are open passages G, which are connected with an annular channel H into which combustible gas may, if necessary, be led and added to the gas produced inside the retort. In the lower chamber other passages K are provided, and they are connected with an annular channel L, which may be supplied with air. The passages M communicate with the channel N, which is supplied with a combustible gas free from air or oxygen and the same as that produced in the retort.—*October 18th* 1919.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

JUNIOR INSTITUTION OF ENGINEERS.—Caxton Hall, S.W. 1. Paper, "Friction," by Mr. C. Hubert Plant. 8 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, W. 1. Discourse, "Problems in the Variability of Spectra," by Professor T. R. Merton. 9 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS.—Memorial Hall, Albert-square, Manchester. Paper, "Recent Developments on the Manchester Ship Canal," by Mr. Wm. FOX. 7 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Lecture Theatre, Literary and Philosophical Society, Newcastle-on-Tyne. "Diesel Engine Design," by Mr. Paul Belyavin. Discussion. 6.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS: NORTH-EASTERN SECTION.—Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne. Special meeting. "Some Impressions of America, with special reference to Engineering Practice," by Dr. J. R. Beard. 7 p.m.

THE ELECTRO-HARMONIC SOCIETY.—The Great Hall, Cannon-street Hotel. Smoking concert (last of the season). 8 p.m.

SATURDAY, MARCH 11TH.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, W. 1. Lecture II., "Radioactivity," by Sir Ernest Rutherford.

KEIGHLEY ASSOCIATION OF ENGINEERS.—Assembly Room of the Cycling Club, Cavendish-street. Lecture, "Foundry Practice," by Mr. C. Webster. 6 p.m.

ASSOCIATION OF ENGINEERING AND SHIPBUILDING DRAUGHTSMEN.—University Engineering Building, Liverpool. "Socialism: Yesterday, To-day and To-morrow—A Critical and Historical Study," by Rev. S. A. Mellor, Ph.D. 7.30 p.m.

MONDAY, MARCH 13TH.

INSTITUTION OF LOCOMOTIVE ENGINEERS.—Leeds Y.M.C.A., Albion-place. Paper, "Notes on the Influence of Design on Express Locomotive Performance," by Mr. C. J. Allen. 7 p.m.

INSTITUTE OF TRANSPORT.—Institution of Civil Engineers, Great George-street, Westminster, S.W. 1. Paper, "Railway Problems in China and Australia," by Mr. T. R. Johnson. 5.30 p.m.

TUESDAY, MARCH 14TH.

THE INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—Chamber of Commerce, New-street. Paper on "The Mechanical Properties of Pure Rolled Zinc," by Mr. D. H. Ingall. 7.30 p.m.

INSTITUTE OF METALS: SCOTTISH LOCAL SECTION.—Rooms of the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. Annual general meeting. Paper on "Motion Study and its Application to Training, with particular reference to Metal Polishing," by Dr. R. S. Hutton. 7.30 p.m.

THE INSTITUTION OF ELECTRICAL ENGINEERS: SCOTTISH CENTRE.—The North British Station Hotel, Edinburgh. General meeting. Paper, "Telephone Line Work in the United States," by Mr. E. S. Byng. 7 p.m.

INSTITUTION OF PETROLEUM TECHNOLOGISTS.—At the House of the Royal Society of Arts, John-street, Adelphi, W.C. 2. General meeting. Address by the President, Professor J. S. S. Brame. 6.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Meeting of the Coventry Graduates at the Broadgate Café, Coventry. Paper, "Modern Developments in Rear Axle Design," by Mr. R. N. Aveline. 7.45 p.m.

WOMEN'S ENGINEERING SOCIETY.—Club Room, 26, George-street, Hanover-square, W. 1. "Women's Place in Industry," by Mr. F. S. Button. 6.15 p.m.

INSTITUTE OF MARINE ENGINEERS.—The Minories, Tower Hill, E. 1. "The Still System of Internal Combustion Engine for Marine Propulsion," by Mr. F. L. Martineau. 6.30 p.m.

WEDNESDAY, MARCH 15TH.

INSTITUTION OF CIVIL ENGINEERS: MANCHESTER AND DISTRICT ASSOCIATION.—Paper on "The Engineering Aspect of the Heating and Ventilating of Buildings," by Mr. J. N. Ellis. 6 p.m.

INSTITUTION OF CIVIL ENGINEERS: STUDENTS' SECTION.—Great George-street, S.W. 1. Lecture I., Vernon Harcourt Lectures, "The Great Ship Canals of the World," by Mr. Gerald Fitzgibbon. 6 p.m.

NORTHAMPTON ENGINEERING COLLEGE ENGINEERING SOCIETY.—St. John-street, Clerkenwell, E.C. 1. Paper on "Developments of Aeroplane Design," by Mr. R. H. Walmsley. 5.30 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C. 2. "Certain Aspects of the Problem of Exchange Stabilisation," by Mr. O. T. Falk. 8 p.m.

SOCIETY OF GLASS TECHNOLOGY.—St. Thomas' Hall, Stourbridge. (a) "Some Notes on the Production of Colourless Glass in Tank Furnaces," by Mr. A. Cousen and Professor W. E. S. Turner; (b) "A Review of the Preliminary Specifications for Refractory Materials used in the Glass Industry," by Mr. W. J. Rees. 2.45 p.m.

ROYAL METEOROLOGICAL SOCIETY.—49, Cromwell-road, South Kensington. Lecture on "Seiches; and the Effect of Wind and Atmospheric Pressure on Inland Lakes," by Dr. E. M. Wedderburn. 7.30 p.m.

THE INDUSTRIAL LEAGUE AND COUNCIL.—Caxton Hall, S.W. 1. "Some Common Fallacies on Trade and Industry," by the Right Hon. G. N. Barnes. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: BIRMINGHAM GRADUATES.—At the Chamber of Commerce, New-street, Birmingham. Messrs. T. R. Florance and C. A. Edwards will open a debate on "Air Cooling *v.* Water Cooling." 7.30 p.m.

THURSDAY, MARCH 16TH.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, W.C. 2. "Phantom Telephone Circuits and Combined Telegraph and Telephone Circuits Worked at Audio Frequencies," by Mr. J. G. Hill. 6 p.m.

ROYAL AERONAUTICAL SOCIETY.—At the Royal Society of Arts, 18, John-street, Adelphi, W.C. Paper, "Radiological Inspection Works," by Dr V. E. Pullin. 5.30 p.m.

THE INSTITUTE OF METALS: LONDON LOCAL SECTION.—Sir John Cass Technical Institute, Jewry-street, Aldgate. Paper on "Micro-structure and Physical Properties of Alloys," by Dr. D. Hanson. 8 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Meeting of the London Graduates at 28, Victoria-street, London, S.W. 1. Paper, "A Suggestion for the Ideal Utility Car Engine," by Messrs. E. Chatterton and L. F. Watson. 8 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS: STUDENTS' SECTION.—Chemical Lecture Theatre, Municipal College of Technology, Sackville-street, Manchester. Open meeting. 7 p.m.

FRIDAY, MARCH 17TH.

THE INSTITUTION OF MECHANICAL ENGINEERS.—The Institution, Storey's-gate, St. James's Park, S.W. General meeting. "British and American Locomotive Design and Practice," by Mr. P. C. Dewhurst of Kingston, Jamaica. 6 p.m.

FARADAY HOUSE OLD STUDENTS' ASSOCIATION.—Queens' Hotel, Leicester-square, W.C. 2. Smoking concert. 8 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—Caxton Hall, S.W. 1. Lecturette, "Power Factor Improvement," by Mr. G. H. Ayres. 8 p.m.

INSTITUTE OF TRANSPORT.—Royal Society of Arts, John-street, Adelphi, W.C. Lecture, "The Operation of an Omnibus Company, with reference to Capacity and Cost under Given Conditions," by Mr. F. Pick. 5 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, W. 1. Discourse, "The Pigments and Mediums of the Old Masters," by Professor A. P. Laurie. 9 p.m.

THE INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—Mappin Hall of the University of Sheffield, St. George's-square. Paper on "Some Nickel Alloys," by Mr. W. R. Barclay. 7.30 p.m.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE.—24, Royal Technical College, George-street, Glasgow. "The Work of Sorby and the Development of Metallography," by Professor C. H. Desch. 7 p.m.

SATURDAY, MARCH 18TH.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, W. 1. "Radioactivity." Lecture III. By Sir Ernest Rutherford. 3 p.m.

MONDAY, MARCH 20TH.

THE INSTITUTION OF MECHANICAL ENGINEERS: GRADUATES' SECTION.—The Institution, Storey's-gate. Paper, "Hydro-electric Course at the University of Grenoble," by Captain H. Whittaker, late R.E. (A.M.). 7 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: SCOTTISH CENTRE.—At the Royal Technical College, Glasgow. Paper, "The Design and Functioning of Laminated Automobile Suspension Springs," by Mr. A. A. Remington. 7.30 p.m.

BRADFORD ENGINEERING SOCIETY.—Technical College, Bradford. "The Heat Extraction Engine," by Professor G. F. Charnock. 7.30 p.m.

TUESDAY, MARCH 21ST.

THE INSTITUTION OF CIVIL ENGINEERS.—Paper, "All-electric Automatic Power Signalling on the Metropolitan Railway," by Mr. William Willox. 6 p.m.

INSTITUTION OF PETROLEUM TECHNOLOGISTS.—Connaught Rooms, Great Queen-street, London, W.C. 2. Annual dinner.

INSTITUTION OF AUTOMOBILE ENGINEERS: LOUGHBOROUGH GRADUATES.—At the College, Loughborough. Paper, "Electric Lighting and Starting Sets," by Mr. G. A. Pearson. 7 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Ordinary general meeting of the Institution at Broadgate Café, Broadgate, Coventry. Paper, "The Design and Functioning of Laminated Automobile Suspension Springs," by Mr. A. A. Remington. 7.45 p.m.

WEDNESDAY, MARCH 22ND.

INSTITUTION OF CIVIL ENGINEERS: MANCHESTER AND DISTRICT ASSOCIATION.—Paper on "Earth Pressures and Retaining Walls," by Mr. W. B. Wignall. 6 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Visit of the Birmingham Graduates to the Bearing Works of Rudge-Whitworth, Limited, Reddings-lane, Sparkhill, Birmingham. Graduates will meet outside the works at 2.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: NORTH OF ENGLAND CENTRE.—At the Assembly Room, Education Offices, Salford, Manchester. Paper, "Torque Diagrams for Internal Combustion Engines," by Mr. A. T. J. Kersey. 7.30 p.m.

THURSDAY, MARCH 23RD.

CHADWICK PUBLIC LECTURES.—Gallery of Royal Institute of British Architects, 9, Conduit-street, W. 1. Two lectures on "Water." Lecture I.: "Its Storage and Filtration," by Mr. H. E. Stilgoe. 8 p.m.

FRIDAY, MARCH 24TH.

INSTITUTION OF PRODUCTION ENGINEERS.—Institution of Mechanical Engineers, Storey's-gate, S.W. Paper, "Inspection Methods," by Mr. E. Fairbrother. 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Caxton Hall, S.W. 1. Question and General Discussion Meeting. 8 p.m.

SATURDAY, MARCH 25TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS: NORTH-WESTERN DISTRICT.—Council Chamber, Town Hall, Blackpool. 11 a.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Visit of the London Graduates to the works of the Skefko Ball Bearing Company, Limited, Luton. Graduates will catch the 1.40 p.m. train from St. Pancras, arriving at Luton at 2.25 p.m., and will be met at the station by a representative from the works.

TUESDAY, MARCH 28TH.

THE ENGINEERS' CLUB.—Manchester. Annual general meeting. 1.45 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: COVENTRY GRADUATES.—At the Broadway Café, Broadgate. Paper, "Road Transport Tires," by Mr. G. M. Martineau. 7.45 p.m.

THURSDAY, MARCH 30TH.

CHADWICK PUBLIC LECTURES.—Gallery of Royal Institute of British Architects, 9, Conduit-street, W. 1. Two lectures on "Water." Lecture II.: "Its Distribution and Use," by Mr. H. E. Stilgoe. 8 p.m.